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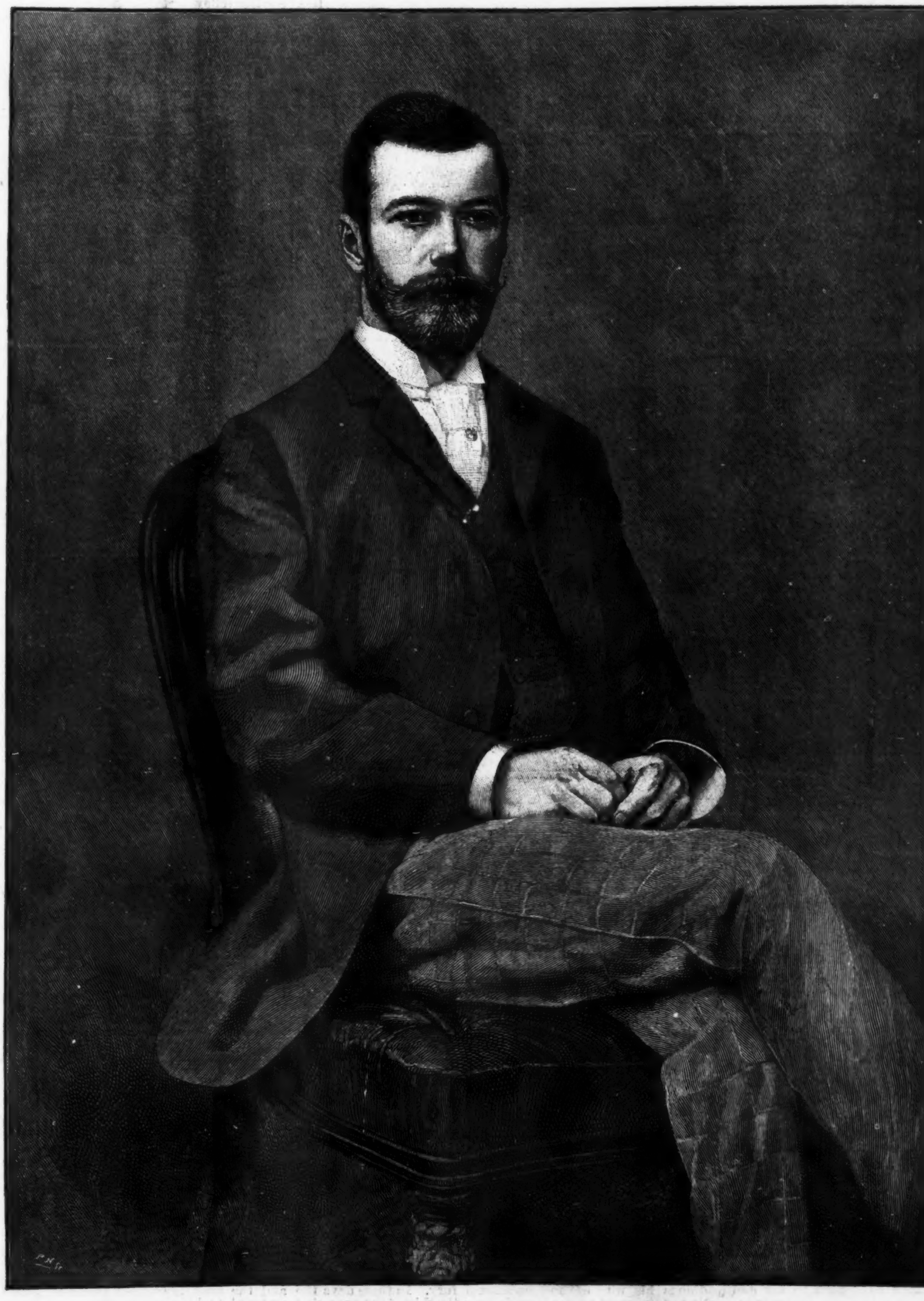


HIS IMPERIAL MAJESTY NICHOLAS II., THE NEW CZAR OF RUSSIA.

[FROM THE ILLUSTRATED LONDON NEWS.]

THE NEW CZAR OF RUSSIA.

Speaking mathematically, Nicholas II. of Russia is x—an unknown quantity. Ascending the throne with but little warning, assuming responsibilities after small opportunity of apprenticeship to his great office, the new Czar and Autocrat of all the Russias has centered upon him the critical eyes of the civilized world. Like those nations which are esteemed happy, he has, comparatively speaking, no history. Grand Duke Nicholas, as his correct title was prior to his father's death, was born May 6 (old style), 1868, the eldest son of Alexander III. and Maria, his wife. An uneventful boyhood, spent for the most part in company with his ailing brother, Grand Duke George, was followed by travel in various parts of the world. It will be remembered that he visited Japan in company with his cousin the Crown Prince of Greece, who valorously saved the Czarevitch's life from the assault of a mad assassin. In India he had especial opportunities of examination of the great engineering works and other interests in that mighty empire, so specially interesting to Russia. One of the reasons for his visiting Great Britain on the occasion of the Duke of York's wedding was in order that he might personally thank the Queen for the reception he was accorded in the land over which she rules as empress. In this country the Czarevitch thoroughly enjoyed himself, and created a much more favorable impression than report had prophesied. By the side of the Duke of York it was difficult at a distance to distinguish which of the young men was the heir to the Russian throne. He spent much of his time with the Queen, who was specially interested in his matrimonial engagement to Princess Alix of Hesse. The new Czar is, like the Prince of Wales, an admirable linguist. He is receptive of new ideas, and admires the freedom which is the proud possession of these isles. As Thomas Carlyle maintained, nothing is more cowardly than attacks on the characters of royal personages, who by their position are prevented from replying. And we are sure that Englishmen all the world over will sympathetically regard Nicholas II., and hopefully expect that he will bear himself manfully and wisely in his new heritage.—Illustrated London News.

KING AGOLIAGBO OF DAHOMEY.

That most ill-famed army of King Behanzin, perhaps the most blood-thirsty tyrant that ever disgraced an African throne, has come to an end during the past year, and France has been able to install herself in the realm of this negro potentate. But it has been thought best at Paris to continue the old conditions, with, of course, the necessary changes, and allow the brother of the defeated autocrat to succeed him. He will, however, be under strict surveillance of the French governor of the newly acquired colony of Dahomey and dependences. His political career is ended, human sacrifices, such as were frequently offered, will no longer be allowed, and the celebrated amazon guard with its brilliant armor has vanished, but otherwise the new King Agoliagbo is allowed to live in the old way.

The present ruler is about 35 years old, tall and powerfully built. His bearing is without constraint, might also be called proud. The color of his skin seems not to be quite as dark as that of his subjects, but his hair is just as woolly, his beard is very thin and the mustache entirely lacking. With his high forehead and broad face, there certainly is nothing attractive about his countenance, but, on the other hand, there is nothing alarming until he is irritated, and then his sparkling little eyes and wrinkled forehead show that the tiger was only slumbering.

Our engraving shows Agoliagbo in his gala costume which he wears on great occasions. It consists of an apron of silk and many colored satin that is drawn around his loins and extends up to his left shoulder, where it is held by the scepter. His head is covered by a white cap decorated in front with three cockades, one above the other, and tinsel, and in front of his nose hangs a perforated silver plate, by means of which the king keeps all improper substances from his aristocratic nose.

His black majesty is always surrounded by his favorite women, the elite of his harem. One hands him his spittoon, another drives away troublesome flies, a third dries his perspiring breast, while others carry his sun umbrella or take care of his numerous smoking utensils. The King Agoliagbo is a great consumer of tobacco; he is separated very seldom from his long pipe with a silver head, and then only to smoke a bad cigar with the help of a holder, of which he has a great variety.—Illustrirte Zeitung.

BOOKBINDING: ITS PROCESSES AND IDEAL.

By T. J. Cobden-Sanderson.

Bookbinding is in itself a comparatively simple matter, and is easily described; but it is associated with great and interesting conditions of society, and, at its highest, rises into disinterested admiration by such means of expression as are within its reach of what is most beautiful and wonderful in human achievement, the written and printed speech of man. Binding, moreover, like every other handicraft, is, on its ideal side, a discipline and a type of life. I propose, therefore, to explain, indeed, how a book is bound, and how, when bound, it may be tooled. But I propose, also, as far as I may be able, throughout to put the craft in imaginative sympathy with the thought it would perpetuate; to touch upon its origin, its history, and its patrons; to characterize the styles of the great periods of tooled decoration; to insist upon the need of some new departure in the invention and development of motive and of pattern; and, finally, leaving the special objects of the binder's craft, to find in the intuition of the harmony of the universe an outline of the ideal of the craftsman and of the artist.

I have, then, in the first place to ask you to transport yourselves to the dawn of intelligence and to imagine man, confronted with the wonders of existence, struggling to give expression to his multitudinous thoughts, and to give to them, otherwise as fleeting as the clouds which vanish as they rise, something of the permanence of the permanent and stable world about him. In this early struggle to perpetuate thought originates the craft of the binder. At the outset, however, we must distinguish between two fundamentally different methods of perpetuating expressed thought. In the one—the more ancient—the "binding," if I may so stretch the word, or that which gives permanence to the thought, precedes the writing, and is generally some natural object already having a permanency of its own, as the earth itself or the face of the mountain side. In the second—the more modern—the writing precedes the binding. The distinction is fundamental, yet the purpose in each case is the same; and so, at once to give completeness to our subject, and to trace it to its veritable origin, the ambition of mankind to perpetuate its written thought, we are entitled, and I think obliged, at least to mention as forms of binding the permanent natural objects, the earth, the mountain, the rock, pillar, tablet of stone, and column, upon which writing was first incised with a view to its transmission to posterity; a method of perpetuation which subsists, of course, in our public and other monuments at the present day. It was only, however, when writing was made upon separate pieces, or sheets, of a pliable and perishable material, that binding proper was invented to hold the pieces or sheets together, and to give strength to them and protection and beauty.

But here again we must distinguish. The pliable written sheet may be either rolled or folded, each giving rise to a form of binding peculiar to itself. The rolled sheet is bound by fastening each sheet to the other sideways, and rolling the whole from end to end, the last sheet serving as a cover to all the rest. This form of binding is no doubt the more ancient of the two, and it was for a long time in general use. It was used, for example, by the Egyptians—it was probably invented by them—and it was used by the Greeks and by the Romans, and great libraries of rolls existed for some time after the Christian era, and many industries were engaged in contributing to the perfection of the binding. It has, however, been superseded for many centuries by the folded form of literature, the invention of which is attributed to Eumenes, King of Pergamus (from whom, too, comes our parchment or skin prepared for writing on) in the third century before Christ. But if the form has disappeared, the terminology of the roll has survived, and the word "volume," originally a thing that is rolled or wound up, i. e., a roll, is now applied indiscriminately to its substitute, the book of folded sheets.

The folded sheet, or section as it is called, is bound by simply sewing or otherwise fastening the parts of the sheet to one another at the back crease or fold, and a number of sections are bound by fastening each of them to some common support at the back, so that when all are sewn or otherwise fastened, they may yet be free to open and to shut at pleasure at the front or "fore edge."

The invention of the folded sheet thus gave rise to the invention of modern binding, which in its essence is the union, at the back, of the folded sheets, which together constitute the folded book, or, as I may say, despite the latent contradiction, the folded volume.

It would be interesting at this point to pause and trace, if we can, the history of modern binding as thus defined to the present time, but it is too vast a subject even to outline. I will only say in passing that at each successive epoch the form of the binding adapted itself to the state of literature at the time. When books were few and large and stationary, the binding was correspondingly large and bossy and heavy; and when books became numerous and light and portable, the binding adapted itself to the new conditions, and, dropping the oak boards, the brass fittings, clasps, bosses and chains, became itself light and portable and beautiful. And thus wood and silk and velvet and leather, iron and brass and silver and gold and precious stones were all used by the artificers, the black, the gold and the silver smiths of the middle and earlier ages, in the protection and embellishment of the world's written wealth. The invention of printing, however, and the multiplication of books gave the victory to leather and to gold tooling, and with the invention of printing binding passed into its modern phase and became ultimately a craft apart—the craft of the bookbinder.

But before passing on I must, to exert the spell of great and beautiful names and associations, mention at least one or two of the patrons who have given to bookbinding the renown which it still enjoys. Persia, Constantinople, Italy, Germany, France and England have all contributed, but in the greatest degree France, and to France and Grolier we are mainly indebted for that gold tooling which is still the chief means of making the bound book beautiful. Let me invoke, then, to shed luster upon our subject, the great name of Grolier, and the, in this respect, truly royal Kings of France, Francis I. and Henry II., III., and IV., and, to crown all, the women, Diane de Poitiers, Marguerite de Valois and Mary Stuart, famous and beautiful, who loved beautiful books in beautiful bindings, and gave to them something of the aroma of their own high, strange lives—bindings which still live to touch us with their beauty and to restore to us for a moment the long vanished past. The names of the binders of the same great period are, with one or two distinguished exceptions, not known to us, and them accordingly I must pass by in silence; but we may yet admire the work they have left to us, and rejoice in the generosity of genius which can produce and perpetuate, and be content to be itself forgotten.

Deserving of mention, too, or at least of suggestion, as I pass, are the innumerable contributory crafts and industries upon which the binder's craft depends—crafts for the production of materials, and crafts for the production of tools. The binder of the present day uses many materials—threads of flax and silk, cord, paper, machine and hand made boards, milled and paste, cloth, silk, velvet, parchment, vellum, calf and morocco. In the old and, in this respect, happier days, binders used occasionally to be presented with the wild deer of a forest for their skins—and the skins of the wild animal are the best, the toughest, and the strongest, though they are sometimes disfigured by scratches and bruises, the signs and tokens of his wild life and occasional fury. In these days the morocco we use is made from the skin of the goat, civil and domesticated, which grazes under supervision on the mountains of Switzerland or the Cape, and elsewhere, and yields a skin not always as good as the binder could wish, yet sometimes good enough.

The tools are simple; a press, a sewing frame, needles, a folding stick, a saw, a hammer, and so on. But in the production of these tools and materials many and different crafts are employed, each of which must have achieved a sufficient degree of perfection to make the binder's own craft possible; and this collaboration of crafts to one common end is a fact of primary importance, and should always be borne in mind, in order that the solidarity of all industries may be understood and the dignity of each be appreciated.

To come closer to our subject. Binding may be divided into two main divisions:

1. Bindings for use.
2. Bindings for beauty's sake.

I do not mean to say that the useful may not be beautiful, or that the beautiful may not be useful. I mean only that of a certain class the utility of the binding is the characteristic or the main consideration and that of a certain other class not the utility of the binding, but the beauty of the decoration is the prominent feature.

The first class—bindings for use—is divisible into the two following sub-classes:

1. Temporary bindings, or binding for temporary use only, such as the paper covers of our magazines, and the cloth covers in which books are issued in England to the public; and

2. Permanent bindings, or bindings intended to last as long as the binder can make them to last. These bindings are usually covered with leather, wholly or in part, giving rise to the further subdivision of (a) whole bindings and (b) half bindings.

All these bindings may be, and usually are, decorated in some way or other. In cloth binding we have some beautiful designs invented by contemporary artists. But I cannot admire the execution of such designs in gold on so poor a material as cloth, nor is the kind of binding suitable for elaborate invention. The gold soon wears away, the cloth wears out, the sewing gives, and the joints break, and I know not anything more pitiable in art of the kind than to see such lovely patterns subjected to such indignities. It is a true principle in art that nothing should be so made as to degrade in the use, and I should be glad if artists would cease to design for cloth, and if publishers would cease to ask them; and, most important of all, as most effective, if the public would cease to patronize them by selection. Nor would I decorate highly, or at all, half-bound books. A half-bound book is an economy, and economy is incompatible with decoration. Decoration in all its affluence and as a distinctive mark of appreciation is, or should be, reserved exclusively for bindings of the best kind, and for books that are in themselves beautiful and worthy of conspicuous honor. The community does not—or, to speak more exactly, should not—dedicate statues to the memory of the commonplace; nor should we enshrine to perpetuity in a beautiful binding the ephemeral productions of the moment. The beautiful book, then, the work of genius, the immortal in literature, that is, or should be, the exclusive object of the binder's craft when heightened by the art of the decorator. And the decoration should be done for the delight of it, and it should be done in honor of him whose genius it should be a delight to honor. This much I premise in explanation of the kind of book to be bound and made outwardly beautiful, that the labor of the artist may not seem to be thrown away, nor the aim of his endeavor to be mistaken.

I now proceed to describe how such a book may be bound, and how, when bound, it may be decorated.

1. The first operation of the modern binder is to fold or refold the printed sheet into a section, and to gather the sections, numbered or lettered at the foot, in the proper order into a volume.

2. Then "end papers"—sections of plain or colored paper added at the beginning and end of the volume to protect the first and last, the most exposed, sections of printed matter constituting the volume proper—having been prepared and added, the sections are beaten, or rolled, or pressed, to make them "solid."

3. The sections are then taken, one by one, placed face downward in a frame, and sewn through the back by a continuous thread running backward and forward along the backs of the sections to upright strings fastened at regular intervals in the sewing frame.

This process unites the sections to one another in series, one after the other, and permits the perusal of the book by the simple turning of leaf after leaf, upon the hinge formed by the thread and the back of the section.

A volume, or series of sections, so treated, the ends of the strings being properly secured, is essentially "bound;" all that is subsequently done is done for the protection or for the decoration of the volume or of its cover.

4. When sewn—and it is usually sewn by women—the volume passes into the hands of the "forwarder," who "makes" the back, beating it round, if the back is to be round, and "backing" it, or making it fan out from the center to right and left, and project at the edges to form a kind of ridge to receive and to protect the back edges of the boards which form the sides of the cover.

5. The back having been "made," the "boards" (made of millboard now, but originally of wood) for the protection of the sides are made and cut to shape, and attached by lacing into them the ends of the strings upon which the book has been sewn.

6. The boards having been attached, the edges of the book are now cut smooth and even at the top, bottom, and fore edge, the edges of the boards being used as guides for the purpose. In some cases the order is reversed, and the edges are first cut, and then the boards to match them.

7. The edges may now be colored or gilt, or both colored and gilt, and if it is proposed to "gauffer" them, or to decorate them with tooling, they are so treated at this stage.

8. The headband is next worked on at head and tail, and the back lined with paper or leather or other material to keep the headband in its place and to strengthen the back itself.

The book is now ready to be covered.

9. If the book is covered with leather, the leather is carefully pared all round the edges and along the line of the back, to make the edges sharp and the joints free.

10. The book having been covered, the depression on the inside of the boards caused by the overlapping of the leather is filled in with paper, so that the entire inner surface may be smooth and even and ready to receive the first and last leaves of the end papers, which finally are cut to shape and pasted down, leaving the borders only uncovered.

Sometimes, however, the first and last leaves of the "end papers" are of silk and the "joints" of leather, in which case, of course, the end papers are not pasted down, but the inside of the boards is independently treated, and is covered sometimes with silk, as the case may be.

The book is now completely "forwarded" and passed into the hands of the "finisher" to be tooled or decorated, or "finished," as it is called.

The decoration in gold on the surface of a bound book is wrought out, bit by bit, by means of small engraved brass stamps called "tools." The steps of the process are shortly as follows:

1. The pattern is first worked out with the tools, blackened in the smoke of a candle or lamp, upon a piece of paper cut to the exact size of the portion of the book to be decorated.

2. The piece of paper with the pattern upon it is then applied to the surface to be decorated and the pattern is re-impressed on the paper and so through on to the surface of the book.

3. The paper is now removed and the pattern on the book is re-impressed with hot tools to make the impression crisp and distinct.

4. At this stage a different process begins. The surface of the cover, with the pattern impressed upon it as described, is taken bit by bit and treated as follows:

1. First it is moistened with water or vinegar.

2. Then the pattern is penciled over with "glaire," which is a liquid composed of the white of an egg beaten up and drained off.

3. Then when the glaire is dry, the surface is lightly touched with oil or grease to give a hold to the gold leaf next to be applied.

4. Then the gold leaf, cut to the size and shape of the portion of the cover to be operated on, is applied by a flat brush called a "tip," and pressed down by a pad of cotton wool to reveal the pattern underneath.

5. Then, and finally, the pattern with the gold upon it is gone over again with the hot tools, and the gold is impressed into it; the rest of the gold is rubbed away with an oiled rag and the pattern is now displayed permanently in gold and "finished."

The description is easy—how easy! but the craft is difficult. Gold cannot be persuaded to stick as a friend may be persuaded to stay; it must be made to stick—i. e., all the conditions upon which successful gold tooling depends must in all cases be observed, and there is the rub! What in each case—and the circumstances are never quite the same—are the conditions? How divine them? A little more, or a little less, makes so much difference. How dry may the leather be, or how damp must it be? How much glaire? How hot must the tools be? When is the moment to begin? Then how difficult it is correctly to manipulate the tools, to keep them even upon the leather! How difficult, finally, to keep the leather, throughout all the long and difficult operation, perfectly clean and the gold brilliant! What patience, what natural aptitude, what acquired skill, what fortitude! Shall I ever succeed? the apprentice may well ask himself. Shall I ever attain to such skill, to such consciousness of power, that I shall not even know how to fail? In this difficulty, too, and in the effort and ambition to overcome it, lies a further difficulty, the snare of the art, the temptation of the finisher. He becomes engrossed in it—the finisher in mere finishing. He pursues it positively, and not in subordination to design. And he achieves victory, at last, only to find that what he should have achieved, the thing beautiful, has escaped him. He can tool, but he cannot design; and he has so magnified execution that when completely successful, when completely triumphant, he is then most conspicuously a failure. The tremulous outline of design—and design appeals to the imagination, to the inner eye of the soul, as well as to the outer eye of sense—the tremulous outline of design has perished in the too great exactitude of his accomplished execution. Wholly to achieve victory, indeed, in the binder's craft, to forget no end in the prosecution of the means, to exaggerate no feature from long practice and perfect skill, to permit no craft of hand to overcome the judgment of the head, is, in bookbinding, as in all crafts, an exceedingly difficult task, and we have in the very development of a craft the cause of its ultimate decay. But what an education the prosecution of a craft is for the soul of a man! The silent matter, which is the craftsman's material, is wholly in his hands; it hears and makes no reproaches, but it never forgives and it has no mercy. Sunrise after sunrise lights the craftsman to his task, sunset after sunset leaves him to his regret. Shall the sun ever rise upon victory or set upon contentment? It is a great struggle. He only knows how great the struggle is who knows what the aim of craft rising into the ideal is, and who tolerates, between him and it, no cloud of self-illusion, no splendor of popular praise to blind or to darken his gaze. And so through the work of his hand man may rise indeed to his soul's height. But the victory itself is withdrawn behind the veil. The world may not know it when it is achieved, and the artist himself may sometimes see it achieved, as he thinks, when to reach it he has yet to traverse the entire way of truth.

AGOLIAGBO, THE NEW KING OF DAHOMEY.—FROM A PHOTOGRAPH.

The great schools of design for the decoration of bound books are the great schools of France of the sixteenth and seventeenth centuries. I do not propose to discuss the origin of the motives or of the several schemes of distribution which alone, or in combination with one another, characterize these great schools. It would indeed be too difficult a task to undertake, for the elements of design go far back in the history of human activity. All mankind would seem, at all times, to have been engaged in decoration of some kind. An intricate network, woven by the flying shuttle of suggestion, covers and holds together the whole of the past and the present. It will be enough to direct your attention to these schools, as schools, and to characterize them in illustration of the principles of design which I shall hereafter attempt to define.

(1) The first great school—the school of Grolier, as it may be called—is characterized mainly by the simple motives of straightness and curvature. Straight and curved bands or straps and straight and curved lines are interwoven one with the other and distributed on a more or less simple or intricate, but always symmetrical, plan over the sides and back, and sometimes the edges of a book. This school is eminently organic or structural, and of great, though of severe beauty. It had for its patrons Grolier and Francis I., and Henry II., and Diane de Poitiers, and is in intimate connection with the beautiful press of Aldus at Venice, and in direct touch with the craftsmen of the East, Greek and Persian. It endured from the end of the fifteenth century to the accession of Charles IX. in the sixteenth century, when it suddenly came to an end, lost probably, men, tools, and craft, in the religious troubles of the time. I may add that the names of no binders are known in connection with this school.

(2) The second great school—the school of the Eves—is characterized by the symmetrical distribution over the side of the cover of symmetrically drawn compartments or panels, and the union of them all into one organic whole by the intermediation of twisted or interwoven bands. This is its main and, for its earlier years, its only characteristic, if we omit the death's heads and cross bones and tears with which its royal patron, Henry III., enriched it. But the school attained its maturity by the combination with it of an independent, contemporary style, which consisted in the use of a number of branches, spreading from each corner of the cover toward the center, the unity of the whole being enhanced by a semis, simple or alternate, of some simple tools over the whole of the side. The combination was effected under the direction, if not by the hand, of the great binders Nicholas and Clovis Eve, and consisted in the enrichment of the interspaces of the first style by means of the sprays and branches of the second. When mature, the school was characterized by compartments, symmetrically distributed and connected, filled with dainty devices or with the several tools of the Grolier pattern, and supported and enriched in the interspaces by foliated branches and sprays.

This school is also very beautiful, more humane, more lovely, perhaps, as if it had felt the touch of a woman's hand, or influence, than the earlier school of Grolier, combining, as it does, the severity of geometrical form and arrangement with the flow and flutter of the self-adjusting foliage and the gracious lines of the palm.

The patrons of this great school are Henry III., Henry IV., De Thou, and Marguerite de Valois, though the latter, perhaps, may be regarded as the special patroness of the style of design peculiarly associated with her name; I mean the little wreaths, inclosing a flower, worked in diaper over the whole of the side. The second school lasted from the time of Henry III. in the latter half of the sixteenth century to the reign of Louis XIII., in the early part of the seventeenth century, and died, we may say, with the Eves, with whom it is specially connected. To help the memory I may mention that the second school is contemporary with Shakespeare, stretching from 1574 to 1610.

(3) The third great school—the school of Le Gascon—and perhaps the last was characterized by the combination with the geometrical framework of the preceding school of a new motive, borrowed, I think, from the contemporary lace, or perhaps filigree work, and used ultimately to fill in both the compartments or

panels and the spaces between them. The motive is an exceedingly simple one, a small spiral of dots, but the close repetition of it has a singularly rich, if somewhat bewildering effect. The school, however, in what especially characterized it, has dropped the tradition of form, and is content with the glitter of gold. The repetition of the spiral, if not without intelligence, which it certainly is not, is at least without active constructive intelligence. The spirals are placed side by side, they do not grow the one out of the other. And I submit that all patterns to be good must be organic in the relation of their details and organic in the method of their development.

This school has for its patrons Louis XIII. and Louis XIV., and for its great binder, the nominal Le Gascon. It lasted from the beginning to the end of the seventeenth century, when it was swallowed up and lost in the excessive splendor which constituted the person of the great monarch. Unlike its predecessors, it had in it, as I have said, an element of formlessness and inarticulate brilliancy, and was the fit prelude to the decadence which, despite the bindings of Padeloup and Derome, we may date from its close.

The great schools of design which I have just attempted to characterize are historical, and they are closed. The future, as I have already had occasion to remark elsewhere, is not, in my opinion, with them or their developments or repetition, however much the present may occupy itself in their corrected iteration.

Design is invention and development, and when development has reached a certain point the invention is exhausted, and some new departure must be taken. No new departure, however, of any importance has been taken since the close of the great schools of France of the sixteenth and seventeenth centuries, and the decoration of bound books is still an open problem awaiting solution by the genius of the present and the future. But, though this problem awaits solution, the conditions of the problem may, I think, be stated shortly in general terms.

In the first place, then, there must be in every design a scheme or framework of distribution. The area to be covered must be covered according to some symmetrical plan. In the second place, the scheme, or framework of distribution, must itself be covered by the orderly repetition and, if need be, modification and development of some primary element of decoration, which, to borrow from the language of music, we may call a motif, or by the orderly repetition and modification of two or more such motifs. In the great French schools which I have just described, the motifs were primarily curved or straight bands or lines and compartments composed of the same, the whole pattern of the first school becoming, in principle, the motifs of the second and third.

Perhaps before I leave this subject of design I may be permitted to prophesy that in the infinite inventions of Nature herself may be found the suggestions for the motifs of the future, and that in seeking them there the craftsman artist will enter again into that vital communion with her which is the condition at once of his own happiness and of his own imaginative growth. But this prophecy must be accompanied by this caution. Design cannot, in my opinion, be taught. It is as distinctly a gift of imaginative genius as the power of poetical vision and expression. To the conditions of the problem, then, must be added the genius suitable for its solution.

I have now, in conclusion, to fulfill the final promise which I made at the outset, and to say what, in my opinion, the craft of binding is, and in what relation it stands to the supreme art and craft of life itself.

All this universe of light and shade and sound, which at all moments surrounds us, and which at the outset I alluded to as constituting the object of man's thoughts, his intranscendent inner and outer self, may be looked upon as itself a work of art in progress, and man's life through the ages as an attempt, ever renewed, to apprehend it in its entirety, and to reduce it to something appreciable by his imagination and his affections. This is not the moment to dwell at length upon this attempt, or to show how, with increasing knowledge of his environment, his previous conceptions of it have perished to give birth to higher and wider appreciations; but I may allege that, in my opinion, all the religions which have figured upon the stage of history, as well as all philosophical and scientific systems, are attempts at this reduction of the universe, and of man as a part of it, to an entirety harmonious within itself, and fit to be the dwelling place of the imaginative soul of mankind. They are attempts, and for some of us they have ceased to be adequate. For myself I see only unbounded space and infinite time, and, within those illimitables, a finite world obedient to law, unfolding to unknown ends; and though I cannot grasp that world in its entirety, yet I can divine the amplitude of its rhythm, be sensitive to its adaptations and to the balance of its parts, and in the spirit of the infinitely great work at the infinitely little and feel the two akin in their adjustments, balance and rhythm.

It is in this intuition of the harmony of the universe that the ideal of the work of the hand resides. It is itself an adjustment at once beautiful and serviceable. It is a dedication of man's powers to an end not beyond man's reach; it develops invention and the imaginative faculties; it distracts the mind from the vexed question, never wholly to be put aside, of man's own ultimate destiny; it gives him rest; it gives him hope, that even as from the work of his own hands here there arise things of beauty and of use, so from his whole life's work and the world's there may arise in the "hereafter," which in some sense may be only another form of the "present," a something of even greater use and greater beauty still.

It is in this wise that I commend to you all the life of the workman, of the workman working in little in the spirit of the whole.—Fortnightly Review.

CONFECTIONERS' FLAVORINGS.

The peculiar and characteristic odors of flowers, leaves, fruits, seeds, roots, barks and woods are due to the presence of essential oils. Without the latter there would be no liqueurs or perfumery, and spices would be unknown. In some plants the oil is found only in the flowers, as the rose and violet; in others, in the fruit, as the nutmeg; in others, in the unexpanded buds, as the clove; in others, in the bark, as certain laurels; and in still others in the outer rind of the fruit, as the orange and lemon.

Italy supplies the world with orange and lemon oils, and the Italians are up to all the tricks of mixing and adulterating. The United States consul general to Italy reports that practically all of the orange and lemon oils which reach the United States are sophisticated to a great extent. Bergamot, the most costly, is adulterated with oil of sweet orange, turpentine, mineral oil, pitch and essence of peppermint. Pitch is employed for coloring, and stearin is added to increase bulk and weight. The most important adulterant is turpentine, which is so nearly related chemically to the oil of lemon—both being terpenes—that its presence as an ingredient can hardly be detected by analysis.

It seems strange to learn that adulterated essences have taken prizes at exhibitions in preference to pure articles. One reason is that their odor is apt to be more agreeable when they are diluted. Oil of lemon, weakened by an admixture of nearly odorless turpentine, has a more pleasant smell than the genuine. A mixture of bergamot, the oil from a small orange of agreeable flavor, with lemon and sweet orange oils, is more pleasing to the nose than the plain essence. It is claimed that such oils keep longer when turpentine is added. Sweet orange and lemon oils are the most difficult to sophisticate without detection.

The bulk of the world's supply of peppermint oil is produced in the United States. In the States of New York and Michigan one hundred thousand pounds of it are manufactured annually, representing fifteen thousand tons of raw material. The latter consists wholly of the fresh flowers of the peppermint plant, which are treated by distillation. One acre of land will produce about eleven pounds of the oil, it is reckoned. It is used for perfumery and to flavor confectionery and cordials, and also for medicinal purposes. Essential oils are distinguished from the so-called "fixed" oils by the fact that the former, when subjected to heat, will wholly evaporate, leaving no trace behind.

USE OF PHOTOGRAPHY IN TOPOGRAPHICAL DRAWING.

There are two cases to be considered in rapid reconnaissances. The operator may either remain for some time in a locality whose plan he wishes to draw to a certain scale or else he may wish to continue his journey without interruption, and content himself with collecting the data strictly necessary for tracing his itinerary on a smaller scale, while at the same time preserving upon such drawing the principal characters of the countries that he has traversed.

In the first case he will have to proceed, as all engineers do, to the measurement of a base as exact as the means at his disposal will permit him, and to a triangulation based thereupon.

We shall offer no advice as to the execution of this preliminary work, but shall merely say that, with our method, since the apices of the triangles are designed in most cases to serve as photographic stations, the operator should be fully impressed with the very important conditions that they must satisfy.

Ordinarily, that is to say, with other methods, it is necessary that each of the summits of the triangulation shall be visible only from the other summits with which it forms the triangles to be calculated. The operations of detail that are based upon these datum points do not require that such summits nor even the signals installed thereupon shall be visible from all the parts of the land that surrounds them. When photography is employed the case is entirely different, and it is necessary to figure to one's self that the ground is entirely bare from one to another of the stations chosen, each point having to be seen from at least two of them in order that it may be determined, as we shall indicate hereafter.

It will sometimes necessarily happen that such condition is not fulfilled and that, consequently, certain details may escape the operation; but if we compare the number of the precise data that one succeeds in collecting in a few days by the aid of photography with the results laboriously obtained in a much longer time by some other process, one will unhesitatingly recognize the immense advantages of the one under consideration. In the case of reconnaissances made without a halt and without leaving the line of the journey projected, the photographic method is again destined to render great services, particularly in an open and uneven country. It may even be asserted that there is no comparison to be instituted between it and all those methods to which we have hitherto been reduced.

It is well to recall here the earnest recommendation made to travelers by Beautemps Beaupré to have recourse to landscape views drawn in the form of panoramas in order to avoid the errors that are so often committed through relying upon the indications of ignorant guides.

Under such inspiration we ourselves employed in the first place as long ago as 1848 geometrically exact picturesque views drawn with the camera lucida in topographical reconnaissances, and it was not until after experimenting with the Beautemps Beaupré method thus improved that we proposed to substitute the camera obscura for the camera lucida as soon as photographic processes began to be applicable on the road.

PROPERTIES OF SKETCHED OR PHOTOGRAPHED PICTURESQUE VIEWS.

Each of the views drawn with the camera lucida or photographed is a conical or central perspective obtained upon a vertical plane. Exceptionally, this plane may be inclined upon the horizon. In all cases it is designated as a picture, and the point of view, which is the center or the summit of the visual rays intercepted by this picture (supposed transparent), is perfectly determined in position by the very nature of the instruments.

With the prismatic camera lucida the point of view is situated upon the side of the interior and upper edge of the prism, in the center of the eye hole of the mounting, and in the camera obscura it is confounded with the optical center or the interior nodal point of the objective. It will suffice to glance at the accompanying figures (1 and 2) to understand the manner in which each of these instruments modifies the position of the picture.

In Fig. 1 we see how the camera lucida, consisting of a quadrangular prism whose two faces act like total-reflection plane mirrors, throws upon a horizontal table (where it is easy to draw it) the image produced directly upon a vertical transparent glass situated in front of the marginal edge of the prism where the observer places his eye and at the same distance as the table.

Fig. 2 shows the effect produced by the objective of the camera obscura, which one can conceive as being reduced to a mathematical point, and which in fact can be replaced by an extremely narrow aperture—a hole formed in a screen.

The reversed image formed at the back of the camera upon the sensitized surface is evidently nothing else, when it is righted, than that which we should see directly upon a transparent glass placed in front at the same distance from the point of intercrossing of what may be considered as the visual rays.

The point, O (Figs. 1 and 2), at which all the visual

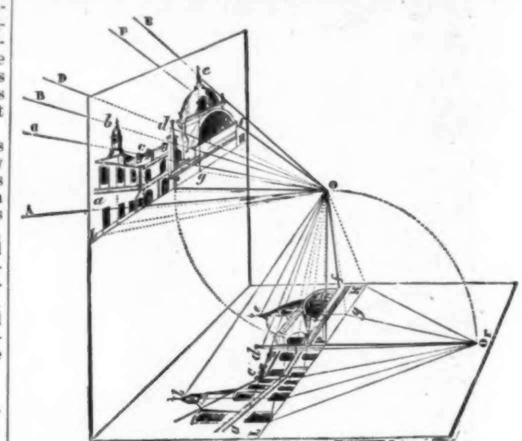


Fig. 1.—PERSPECTIVE DRAWN WITH THE CAMERA LUCIDA.

rays end, we have already called the point of view of the perspective.

Let us, in the two figures, consider the ideal vertical picture arranged in front of the point of view, and conceive the horizontal plane (called the plane of the horizon) which passes through this point; the line, L H, of this plane upon that of the picture is called the line of the horizon, and the length of the perpendicular, O P, from O to L H, is the distance from the point of view to the picture.

Finally, if we likewise pass through the point of view, O, a vertical plane perpendicular to that of the picture, their intersection that crosses the horizon line at the point, P, is called the principal line, and the point, P, itself is the principal point of the perspective. It will be easily seen what becomes of the point of view, the horizon line and the principal point, when, instead of the ideal picture, we consider the real image thrown upon the table of the camera lucida or photographed at the back of the camera obscura.

The distance from the point of view to the picture is the essential element of all the constructions and all the measurements that we have to effect. When it is a question of images drawn with the camera lucida, we have, so to speak, the point of view under our hand, and its distance, O P, from the picture is immediately estimated by means of a divided rule.

Let us suppose such distance determined with great precision, and in order to fix our ideas, let us admit 30 centimeters as the distance of distinct view. On referring to Fig. 1 and following the directions of the visual rays beyond the ideal picture as far as to the corresponding points of the landscape or the structure

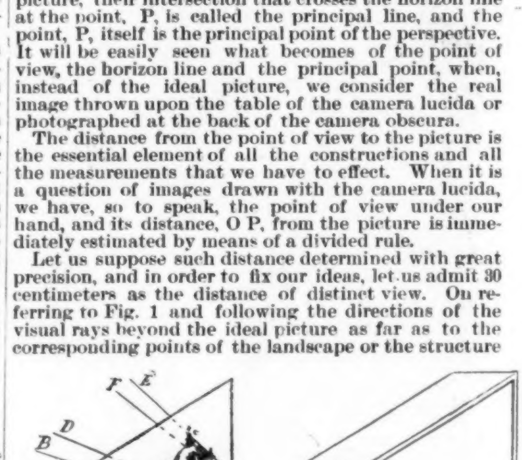


Fig. 2.—PERSPECTIVE OBTAINED WITH THE CAMERA OBSCURA.

represented, we may be convinced that an accurately geometrical image replaces the land or the structure for an ever so slightly experienced topographer. It suffices, in fact, to recall that, in topographical operations, recourse is generally had to goniometrical or goniographical instruments, by the aid of which are measured or drawn the angles reduced to the horizon comprised between the directions of the visual rays of the points that one wishes to determine in horizontal projection and the angles that such visual rays make with the horizon, in order to conclude therefrom the differences of level of these points and of the stations where one operates.

If, for example, we consider, instead of the summits, B and E, of the natural edifices, their images, b and e, and project these images at b' and e' upon the horizon line, L H, and then, through the point of view, O, conceive the two lines, O b' and O e', it is clear that the angle, b' O e', will be the reduction to the horizon of the angle of the two visual rays, O B and O E. Now, in order to obtain such angle graphically, we

have only to lower the horizon plane and, with it, the point of view, O, around the horizon line at O (upon the drawing paper or upon the photograph) and draw the two lines, O r b and O r c'. Upon letting fall in the same way, from all the points that may be selected upon a drawn or photographed image (Figs. 1 and 2), the perpendiculars upon the horizon line and joining their extremities with the lowered point of view, we shall obtain the horizontal projections of so many visual rays that may be used for finding the projections of the corresponding points by the well known method of intersections.

It suffices, moreover, in order to recall this method and to appreciate the results to which it leads when perspectives are employed, to glance at Fig. 3.

The points, A B and C, are stations whence have been obtained, under geometrical conditions as absolute as possible, the views of a landscape or of a collection of buildings.

The two views, a a (transferred to a' a' in order to avoid confusion), and b b, taken from the stations, A and B, have been oriented upon the sheet of paper that has served for the construction of the plan, and in front of each of these stations, according to the three following operations, entirely identical with those that are habitually executed upon the field: (1) measurement of the distance, A B, of the two stations, effected directly or deduced from a triangulation and transferred to the drawing to the scale adopted for the plan; (2 and 3) measurement of the angles formed with the direction, A B or B A, by two visual rays, one starting from the point, A, and the other from the point, B, and ending at the same point of the landscape (in the present case, for example, at the point of the lightning rod seen at the summit of the turret situated toward the center of each of the perspectives). These angles may be, and most usually are, replaced by those that form, with A B or B A, the direction of the principal point of each of the perspectives.

PLANIMETRY.

In order to find the projection of any point whatever recognized at the same time upon the two perspectives, mining the differences of level of all the points of perspectives transferred to the plan.

It must not be forgotten to take account of the height of the instrument, that is to say, of the point of view above the ground of the station. In the present case, this height was noted as 1·4 m., and consequently the difference of level sought was 57·96 m. + 1·4 m. = 59·36 m.

CONSTRUCTION OF A PLAN AND DRAWING OF THE CURVES OF LEVEL.

A comparison of the views that are made to concur in the construction of a part of the plan aids in the quick recognition of the identical points that are to serve in laying out the geometrical line of watercourses, country roads and streets and houses in inhabited places. After these datum lines have been drawn, we pass to the determination of the limits of the principal cultures in civilized countries: woods, fields, meadows, vineyards, orchards, gardens, etc.

In districts remaining in somewhat of a state of nature, one will have to occupy himself in the first place only with the delineation of the watercourses, marshes or lakes. He will afterward endeavor to recognize and determine the portions of the land covered with a sufficiently defined vegetation, and finally the important features of the surface—rocks, dunes, etc.

This planimetric work finished, he will proceed to the determination, or, better, to the simple calculation of the altitudes of as many points as may be judged necessary to obtain in order to well show the relief of the surface and its more or less numerous modifications.

The delineating of the curves of level will next be effected in guiding one's self according to all these datum points and according to the apparent forms faithfully preserved upon the views drawn, and, better still, upon the much more complete photographed views.

It necessarily requires practice in order to succeed well in interpreting the views, and to accustom one's self to the translating of forms that are altered by the perspective; but it cannot be doubted for a single instant that such interpretation, having been made in the presence of exact images that can be consulted at leisure, will be more certainly satisfactory than the improvisations that one is habitually obliged to make in rapidly traversing the country without being able to return to the points of view that have been left behind, and whence one has often badly judged of the forms that he could not suspect before examining them under other aspects.

Such considerations, of which the importance can escape no one, would doubtless suffice to cause travelers to have recourse to photography (or even the camera lucida in certain cases) every time they have a desire to carry home not only more or less precise remembrancers, but also absolutely exact and utilizable data concerning the topography of the countries that they have passed through. It has appeared to me proper, nevertheless, to complete them by very briefly recalling a few facts and dwelling upon several general principles.—A. Laussedat, of the Institute of France.

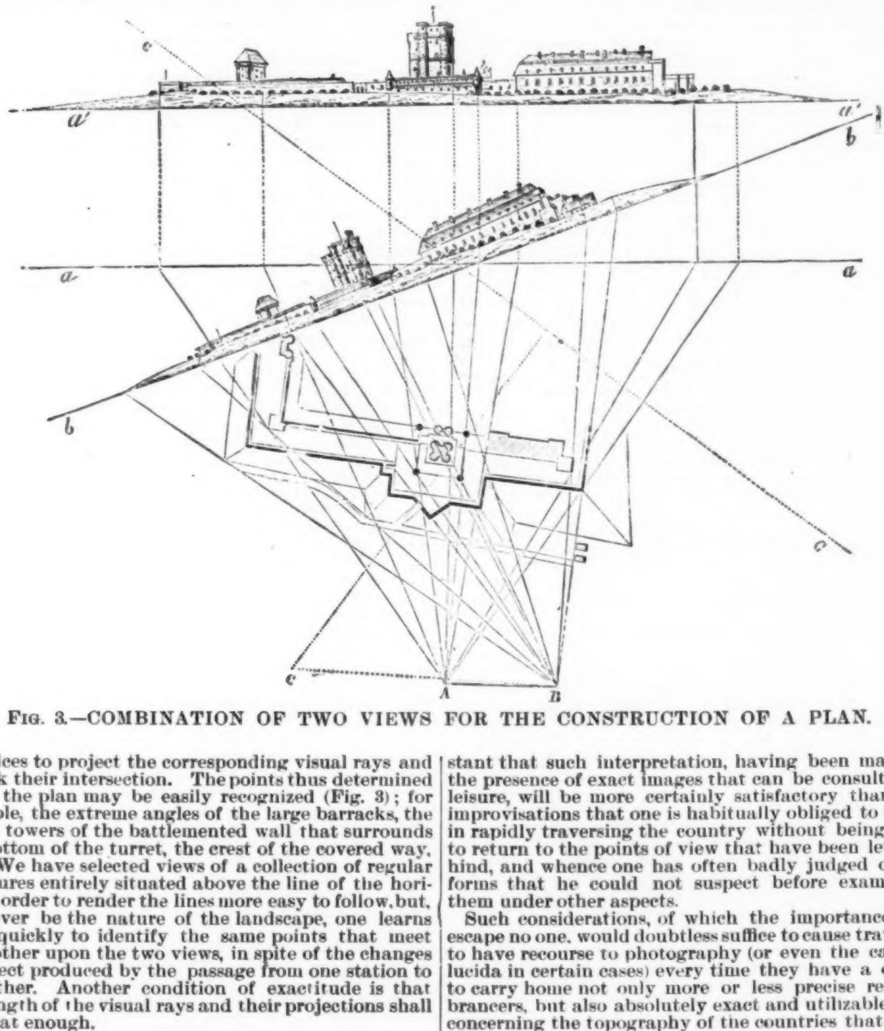


FIG. 3.—COMBINATION OF TWO VIEWS FOR THE CONSTRUCTION OF A PLAN.

it suffices to project the corresponding visual rays and to seek their intersection. The points thus determined upon the plan may be easily recognized (Fig. 3); for example, the extreme angles of the large barracks, the watch towers of the battlemented wall that surrounds the bottom of the turret, the crest of the covered way, etc. We have selected views of a collection of regular structures entirely situated above the line of the horizon in order to render the lines more easy to follow, but, whatever be the nature of the landscape, one learns very quickly to identify the same points that meet each other upon the two views, in spite of the changes of aspect produced by the passage from one station to the other. Another condition of exactitude is that the length of the visual rays and their projections shall be great enough.

LEVELING.

The horizon line of a perspective, like a a, b b, being the line of the horizontal plane that passes through the point of view upon the plane of the picture, all the points of the landscape situated upon such horizon line will be at the same level as the point of view. Upon starting thence, it is easy to see how one can calculate the differences of level of this point of view, and of all the points recognizable. For example, admitting that the plan be constructed to a scale of $\frac{1}{7000}$, if we measure: (1) The apparent height, 15 mm. from the summit of the lightning rod above the line of the horizon; (2) the distance from the point, A, to the bottom of the perpendicular let fall upon the horizon line, 67 mm.; and finally, the distance from this same point to the center of the turret upon the plan, 37 mm.; by the proportion $\frac{67}{15} = \frac{37}{x}$, whence x = 8·28 mm., we shall obtain the real height sought, but reduced to the scale of the plan. It will therefore suffice to multiply it by 7,000 in order to obtain the actual height of 57·96 m.

The same operation, which may be rapidly performed with the calculus rule, permits of thus deter-

RECENT ADVANCE IN PHOTOGRAPHY.*

By E. W. HILL.

AFTER remarking on the rapidity of the progress in the photographic art since, in the year 1839 only, Daguerre announced his discovery that "sun pictures" could be produced in the camera upon a silvered plate, and promising that he should assume an acquaintance on the part of his audience with the rudiments of the "black art" and its terms, the author first alluded to some of the more important of the new

DEVELOPING SUBSTANCES.

The range of substances used for the development of the image formed by exposure has widened considerably since the days when pyrogallic acid and ferrous oxalate were almost the only developers known. Extension in the manufacture of complex synthetical compounds has produced bodies like metol, glycin, amidol, eikonogen, and hydroquinone, which, each for its special purpose, bid fair to supplant pyrogallic acid.

It is by means of the increased activity of the developers employed, as well as by perfection in the making of plates, that pictures are obtained with the exceedingly short exposures we now read of.

ORTHOCHROMATIC PHOTOGRAPHY.

It is well known that the light in the yellow portion of the spectrum possesses the greatest illuminative intensity, and that in the violet the least. But if the yellow rays are allowed to fall on chloride of silver, very little blackening ensues. The actinic rays for haloid salts of silver are those of the violet end of the spectrum, and the invisible rays extending beyond the violet. Consequently, these cause the formation of the image.

If, for example, yellow and dark blue flowers be photographed with an ordinary plate, the resulting print shows the yellow flower nearly black, and the blue one white, or nearly so. As the greatest effect on the eyes is produced by the yellowish rays, a body is required that is also most sensitive to this color, that is to say, "for an exact representation in monochrome, perfect truth can only be obtained when the curve of sensitiveness of the compound to the spectrum follows the curve of luminosity of the spectrum."

A compound possessing this property does not exist, but an approximation may be made by the following process, which constitutes "orthochromatic photography."

A yellow transparent screen is placed before the lens, and this cuts off most of the blue and nearly all the violet rays, as can be easily seen by looking through a piece of yellow glass at a colored drawing or landscape. Into the camera pass the less active green rays and the inactive yellows and reds. Dr. Vogel discovered that the addition of certain dyes altered the position of the maximum of sensitiveness in photographing the spectrum. If, therefore, the plate be treated with such a dye as eosin, its sensitiveness is extended to the yellow rays, which then act to the greatest extent on the plate, and the finished photograph represents well the illuminative values of the different colors. By means of a red screen and a red sensitive plate, truer representations of pictures or subjects in which red is the predominating tint can be obtained. For landscape work orthochromatic developments show a distinct improvement over the ordinary plate; the difference in the value of different shades of greens, or between a blue sky and a white cloud, being well shown.

COLOR PHOTOGRAPHY.

Without noticing the several processes for producing photographs in natural colors that have been from time to time announced, I will describe that published by Dr. Lippman, in 1891, by which actual color photographs have been taken.

To obtain a photograph of the spectrum, he uses an electric arc lamp and condenses the light on to a screen having a very fine slit; after passing through the slit the rays are rendered parallel by a lens and passed through a series of prisms. The decomposed light is projected upon a sensitive plate (specially prepared so that the film is as transparent as possible) by means of a camera and lens. The plate is mounted in such a manner that it forms one side of a cell film inward, which cell is filled with mercury. The light, therefore, from the lens passes first through the glass of the plate, then through the sensitive film, and, striking the mercury immediately behind, is reflected back through the film.

The reason of this arrangement is that when a single ray travels in any direction the supposed particles of ether vibrate backward and forward, so that its path is a series of waves. If another ray starting from the same point travels in the same direction, their crests and troughs corresponding, more light is produced. But supposing one of the rays commences at the distance of half a wave length from that point, the trough of one wave will coincide with the crest of the other, and at certain points—viz., the nodes where the waves cross—the pull on the ether particles will be equal in both directions, and consequently remain stationary. The result is that at these nodes there is no light. This property of light is known as "interference." To return to the spectrum in the camera, and taking for convenience the case of a single ray. Entering the sensitive film it passes through and reaches the mercury at the film's back. It is then immediately reflected back on itself, and "interference" is produced. At the nodes, as there is no light, there is no chemical action, but between them there is increased chemical action, which causes a deposit of silver on development. Thus, through the film a series of layers of particles of silver is obtained alternately with blank spaces. The distance between the layers varies with the wave length of the light. There will be two layers for each wave length, and if formed by a red ray, they will be about half $\frac{1}{35000}$ of an inch apart. Now, when white light strikes one of these finished photographs in natural colors, only that light is reflected which has a wave length of double the distance between two of the layers. Rays of other wave lengths are absorbed; consequently the same color is produced which caused the formation of those particular layers. Per se these photos have absolutely no color, but they sift from white light the particular ray that made them, and this, striking the retina of the eye, gives the sensation of color. You will remember the iridescent colors of the soap bubble or of mother of pearl, which also are produced by the phenomenon of "interference." Mixed colors can be reproduced in the same manner as simple ones. Lumiere has shown specimens, including one of a garden bathed in sunlight, and showing all its colors of flowers and leaves. Another specimen showed a chemist at work, and the metallic, brass color of his microscope, and even the peculiar fluorescent tinge of eosin, were perfectly reproduced.

The difficulties in manipulation being so great, and the fact that only one picture can be obtained, necessitate great improvements in this process before it can come into general use.

Another method of color photography has been published by which any number of copies can be pro-

* Read before the Chemists' Assistants' Association, London, November, 1894.

duced. I must preface this description also with an explanation, as white light is composed of six colors, and thousands of tints may be formed by mixing them in different proportions. And it is remarkable that our eyes possess only three, what are called nerve fibrils, in the retina for observing color, one of which conveys the sensation of red, another that of green, and the third blue. All other sensations of color are due to the simultaneous excitation of two or three of these fibrils to different proportionate degrees. Thus an intermediate color like yellow is produced by the combined action of the red and green. Applying this idea of primary color to photography, three distinct negatives of a colored subject are taken. One is sensitized for red by means of a dye and the use of a colored screen, as in the orthochromatic method, another for blue, and another for yellow. In working with pigments other results are obtained when yellow is employed instead of green. These negatives are like ordinary negatives, black and white; the difference between them is that the red sensitized negative is opaque where reflected red of the subject has impinged, and the blue is opaque where blue light has acted, and the yellow likewise. Three blocks for printing are made, one from each negative, by a process in which a plate of zinc is coated with bichromated gelatine, and after exposure under the negative the unacted gelatine is dissolved away and the plate etched with acid. A print is made from these blocks, inking the block from the negative corresponding to the red with red ink, and the other blocks with their corresponding inks. The impressions are made one after another, each one on the top of the preceding. The result is a print showing all the colors and shades of the original. As with the nerves of the retina, intermediate colors are produced by combinations. Thus, for instance, the green of the print will be produced by a mixture of blue from the blue block and yellow from the yellow, both negatives having been acted upon by the green light.

ASTRONOMICAL PHOTOGRAPHY.

Photography has opened new fields for research by astronomers, and has caused a revolution in the instrumental equipment of the modern observatory. A complete chart of the stars is now being made by means of it. Formerly, to make a catalogue of 10,000 stars was a good twenty years' work for a first class observatory. Now, as many can be registered with absolute accuracy on a single plate. On a clear night the number of stars visible to the unaided eye is only about 3,000. If these were evenly distributed over the sky, a threepenny piece, held at arm's length, would not cover even a single star; but photos of the same area have been taken showing as many as 10,000. It is found that the longer the exposure, the greater the number of stars appearing on the plate, and a well known astronomer has observed that, if we expose plates long enough, we should find not a single spot on the sky but has a star on it.

The camera has almost entirely replaced visual observation for spectroscopic work, for by means of it a complete spectroscopic survey of all stars has been made. The motion of stars traveling in the line of sight can now be determined, just as the whistle of an approaching train sounds shriller than that of a stationary one, while that of a receding train is lower in pitch; so the wave length of the light of an approaching star is shortened, and that of a receding star lengthened.

This is shown when the star's spectrum is photographed. When the waves are shortened, the dark lines of the spectrum are displaced toward the blue, while in the case of a receding star the lengthening of the waves is made apparent by a displacement toward the red. By comparison with the spectrum of a terrestrial element the amount of displacement is measured.

Photo-spectroscopic work has discovered a new kind of binary star. Dr. Vogel, in Germany, found, from photos of some stars taken at different times, that the lines of spectra became periodically doubled. This proved that he was dealing in these cases, not with single stellar bodies, but with two, which were revolving round a common axis. When moving at right angles to the line of sight their spectra became superposed; but moving in opposite directions, the lines of one spectrum became displaced toward the red, and the other to the blue. By measuring the amount of this displacement the rate of evolution of each star was determined; this, with the period of revolution, gives the data for calculating the distance the two components are from each other, also the dimensions of their orbits, and their combined and relative masses. To take an example. From a careful examination of many plates, taken on successive days, of a certain star that shows this doubling, the period of revolution was found to be four days, the rate of movement 150 miles per second, distance from each other 8,000,000 miles and their combined mass 2·3 times that of the sun. No telescope can show this star to be a double, but photography has given absolute proof that it is so.

HIGH SPEED PHOTOGRAPHY.

The construction of mechanical contrivances for exposing the plate for a small fraction of a second has made it easy to obtain pictures of quickly moving objects, such as birds on the wing or trains at full speed. But the depiction of the phenomena accompanying the splashing of a drop or the flight of a bullet requires so brief an exposure that the quickest mechanical shutter is useless. The electric spark is employed, the object being kept in darkness until the moment of exposure. A spark powerful enough to give sufficient illumination, produced by the breaking of a current in a circuit of high self-induction, was not quick enough to give a sharp picture of splashing drops during experiments conducted by Professor Worthington, though its duration was estimated at from four to six thousandths of a second. The spark produced by the discharge of two oppositely charged Leyden jars, afterward used, probably did not exceed one one-hundred-thousandth of a second. To insure the discharge when the falling drop has reached the required position an ingenious arrangement was employed. A metal ball was released simultaneously with the throwing out of the drop from its position in a smoked watch glass. The ball falls between two insulated spheres connected with the inner coats of the Leyden jars, and in passing completes the circuit. The discharge takes place between two magnesium terminals connected with the outer coats of the jars. The terminals are separated to form a spark gap in the focus of a small concave mirror near the place where the drop will splash. The timing of the spark is effected by adjusting the height of the fall of the timing ball. The photos taken in this way by Professor Worthington showed no signs of movement. A similar arrangement is employed for photographing flying bullets. Sharp pictures have been taken which show a cushion of compressed air before the bullet, and waves of air closing in behind like the wake of a vessel.

There are several other branches of photography which might be commented upon. New printing processes are continually springing up. Films of celluloid or gelatine are being used largely as a support for the sensitive emulsion instead of glass. The processes for reproducing photographs for newspaper illustration have very much improved of late years. Then there is the application of photography to the art of healing, where it is used to record the state of a patient, either in fluctuation of disease or progress after operation. But the advance of photography is too extensive for a single paper.

THE RELATIVE EFFICIENCY OF DIFFERENT ABRASIVE PRODUCTS IN COMMON USE.

During the summer and early fall of 1893 I was an active participant in a careful series of experimental tests instituted for the purpose of determining the relative efficiency of different corundums, obtained from many different localities throughout the world.

These tests, at first limited to corundum, finally led to a further series of comparative tests which embraced about all the different abrasive products in commercial use.

After a careful study of the methods employed by different wheel makers, I had previously decided that a certain emery wheel company whose name it is not necessary to mention offered the greatest facilities for the desired tests, and for these reasons:

First. The company members in question were better acquainted from long experience with the manipulation of the product and with its peculiarities than any other individuals of my acquaintance. I was also assured of their cordial personal co-operation in the proposed tests, and for no other reason of return than a desire to add to the very scant information to be obtained upon this subject.

Second. That in order to obtain rapid and continuous results some cement process of wheel making should be employed, as by this process a wheel can be readily made and in operation in twenty-four hours or less, while by the vitrified process it would require from two to four weeks. Also that while the tests were in progress we should no doubt desire for the sake of experiment to change the degree of hardness in the same wheel, to make it over, which we did repeatedly, and that this company possessed all the facilities for so doing.

Third. That a dry running wheel would afford better opportunities for experiment with all products than a wet one, and would in the corundum tests be far more satisfactory and equally efficient.

Fourth. That owing to the long series of tests I proposed making, and the necessarily large number of wheels to be employed, and from the, to me, unknown character of many of the different abrasive products to be tested, the element of safety should be carefully considered, and after a thorough canvass of the subject, I concluded the company in question also employed the safest process. I will add that in all the tests following, employing many wheels of many different products, not one was broken or became impaired in any way, although speeded in the safety test to 4,800 revolutions per minute.

After I decided upon the location for the tests, the matter of a lathe to be used expressly for testing purposes was talked over between us, and as a result, the company immediately undertook to build one in their own machine shop, and under their personal direction. While this was in process of construction and the wheels for the first series of tests were being made, I went to the Chicago Fair for the purpose of gaining additional information upon the subject of wheel tests and abrasive products. During my stay of over a month I had interviews with over three hundred workmen representing as many different concerns, and from all parts of the manufacturing world. I also conversed with American and foreign representatives of abrasive materials who had exhibits, and with others who, like myself, were in search of information; the result being, that I found there prevailed the densest ignorance regarding the relative values and efficiency of the different abrasive products in common use; even among those where it would seem self-interest should have prompted investigation. Not one I met had any knowledge from personal experience of the value of corundum as an abrasive when compared with emery or with the other abrasives. I wish to give a few words of caution and advice to the users of abrasive wheels. To a manufacturing establishment using a large number of wheels per annum, it becomes a matter of dollars and cents to know what abrasive is, for its own uses, the most economical in all that the word implies.

I am aware that but little personal attention is given to this important subject by the heads of such establishments, and that the testimony of a not always unprejudiced workman usually decides the question of the best wheel or abrasive to be adopted, and that competitive wheels, if allowed at all, are accepted or rejected on his statement. Doubtless a little unusual attention on the part of a shrewd agent of a rival wheel concern, perhaps a ten dollar bill, has sometimes had more effect in determining such selection than any careful series of experiments made by him in the interest of his employer. This may be the exceptional case, but I have known such instances. Wheels in the average shop are usually subjected to rough usage, and the same wheel is frequently used in all classes of abrasive work under heavy hand pressure, and speeded without regard to its degree of hardness.

Consequently its average life is short, its efficiency greatly impaired, and its temper and capabilities but imperfectly understood. Never before, to my knowledge and belief, has there been made an absolutely impartial series of tests to determine the relative efficiency of the different abrasive products.

The only previous comparative test between corundum and emery, of an entirely impartial nature, with which I am familiar was made by request of the writer's father, Col. C. W. Jenks, in 1874, at the Springfield Armory, Springfield, Mass. Two wheels of North Carolina corundum were employed in these tests. Col. J. G. Benton, then in command, stated in his report of same, "in one hundred days' work corundum shows a saving over the best emery of about 46 per cent." This test was made in the early days of wheel making and during the experimental stage when the relative efficiencies of hard and soft wheels were but imperfectly understood. The grains of corundum employed in the wheels in question were also of several different numbers, and had been prepared by a process which had completely rounded their sharp cutting edges. No value can or will be attached to any tests when made by one manufacturer of wheels against his competitors for purposes of advertisement, unless the conditions be such as to guarantee absolute impartiality—a very difficult matter under these circumstances. I have seen published statements concerning comparative tests of solid emery wheels, but in each case they were instituted to prove the general superiority of one make of wheel over others. In these tests no reference is made to the different emeries employed, and no mention is made of the fact that the different emeries from different mines here and abroad vary greatly in their cutting efficiency.

In order, however, to impress the public with the entire impartiality of the tests, and the good faith of those conducting the same, it is stated in these published statements that all wheels used in the tests were purchased in the open market.

If such were actually the case, including the wheel it was desired to advertise, then the entire test becomes a matter of chance, no value can be attached to the results, and the report of same is misleading to all seeking accurate information.

If the wheel it was desired to advertise was made with special reference to the test, then the contest was undertaken with the studied intention of hoodwinking the public and the user of abrasive wheels. I am aware that an expert can readily detect the difference between hard and soft wheels, but I hardly think any one will claim the ability to select enough for such a series of tests, in the open market, from the hands of different makers, made by different processes, and to be able to obtain in such a selection the same exact degree of hardness and uniformity in each wheel; conditions that are absolutely essential to an impartial contest. An abrasive wheel is readily made so hard that it will cut but little if at all, and with no perceptible wear, or so soft that, while a rapid cutter, it will wear too rapidly to be economical, and it is a matter of nice discrimination to select from the many varieties of wheels upon the market, and the many degrees of hardness employed by all makers, a wheel even approximately suited to the work it is desired to perform. Some little experimenting would obviously be necessary in order to obtain the same exact degree of hardness required in such a selection. Users of abrasive wheels may be assured that the fault in nine cases out of ten, where a wheel fails to give satisfaction, if not the fault of the abrasive employed, is not the fault of the wheel maker, but a failure on their own part to thoroughly acquaint him with the nature and temper of the work the wheel is expected to perform.

In other words, to obtain the greatest efficiency and economy in wheels, they should be made to order. The wheel maker can, with a little experimenting for the benefit of his customer, make a wheel perfectly adapted to its work, and can accurately determine in each instance the speed necessary for safety and for the greatest efficiency. This once obtained and recorded, he can duplicate the wheel at any time at a great saving to both parties.

On my return to the factory I found the lathe completed and in position, and a large number of wheels ready for the tests.

I will here mention the conditions under which the tests were made, and which were carefully observed by us during the four weeks consumed in our experiments. All wheels of the different products used in competition to be made of the same size grain or number of mesh and each number constitute a series of tests.

All wheels in each series of tests to be made by the same formula, and consequently of the same degree of hardness, of the same exact size, 12 inches in diameter, $1\frac{1}{2}$ inch face, and perfectly balanced; and to be mixed, moulded and handled through the various processes by the same workmen under our personal oversight.

All corundum wheels to be first tested against the accepted standard made from North Carolina and Georgia corundum from the Hampton Emery and Corundum Co., and a careful effort to be made of the comparative efficiency of each corundum. All products to be finally tested against this standard wheel and the relative efficiency recorded. If the standard corundum should prove in the tests greatly inferior in cutting efficiency to some hitherto untried corundum, a new standard should be adopted by us. All emeries to be tested against the one emery which should on all metals prove most efficient. Experimental tests to be made with all the various products, such as quartz against garnet, emery and corundum; carborundum against corundum, emery, garnet, etc. The numbers employed in corundum, emery, garnet, etc., to be 8, 14, 16, 20, 24, 36, 60 and some others, and in carborundum of the largest size obtainable (60), this of course being pitted against a corresponding number in corundum, emery, etc. The lathe employed to carry two wheels on the same spindle, the speed thus being the same during the contest; the feed and pressure to be automatic.

The speed employed in the tests to be from 1,500 to 2,500 revolutions per minute, the pressure to be from $5\frac{1}{4}$ lb. upward, as deemed desirable for the purposes of the test.

The metals employed to be Jessops tool steel in bars $1\frac{1}{4} \times 1\frac{1}{2}$ inch; and cast iron in bars 1 inch square. The wheels to be dressed as required with a Huntington dresser or a diamond, and careful measurements taken to ascertain the wear of wheel material after each test, and the amount of metal displaced to be carefully recorded. Special attention to be given to heat, glazing and other peculiarities.

It may be claimed that another process from the one we employed, the vitrified, changes the character of the abrasive to such an extent as to make it a more durable and efficient wheel. This I can safely assert is not the case where corundum is employed as the abrasive, as the heat obtained in the vitrifying process in no way affects the corundum, and the cements and fluxes used in either process are not selected with special reference to their abrasive properties. Vitrified wheels, especially selected for rapid cutting, although not made under the conditions herein given, of both corundum and emery, were repeatedly tested by us at this time against wheels of approximately the same degree of hardness made by the cement process, and I see no reason to believe a vitrified wheel can be made of either corundum or emery or of any other product which will do more efficient work than a cement wheel of the same products. Some results of the test which will be of interest to users of abrasives are as follows :

That we found a great difference in the cutting capacity of corundum from different localities, due first to hardness, second to structure, third to percentage of impurities contained therein.

One product from a Jackson County, N.C., mine easily distanced all competitors, including the accepted standard wheel, on all metals, and another from the same county was fully up to standard. This was due entirely to the general excellence and purity of both products, with but a slight difference in the structure, which however made one superior to the other. Also that some corundums, after a careful test, were found to possess but little, if any, more abrasive properties than Turkish emery. It is due to these products, however, to say that in the most cases this failure to cut was from an excess of impurity, which from its refractory character could not be readily cleaned, and which would make it undesirable and too expensive to reduce to even comparative purity by any of the present methods employed.

That all corundums so called pure now upon the market contained nearly or quite fifty per cent. of impurity by actual analysis; consequently no accurate determination can be made regarding the efficiency of wheels made of absolutely pure corundum ; but I feel safe in saying, in view of the experiments made with the Jackson County product before alluded to, that the average efficiency of this latter, as compared with the best emery, is as 3 to 1 ; and that the average efficiency of the North Carolina and Georgia standard corundum now upon the market is nearly or quite twice that of the best emery. We also found that the different emeries manufactured by different concerns, and taken from different mines, both here and abroad, are as different in their efficiency as is the case with corundum. The character of the impurities contained in the standard, and in other corundums, varies greatly, and varies also in cutting efficiency. Garnet and quartz, in themselves fairly good abrasives, constitute fully three-fifths of the impurity in the standard. Were the impurities in this product of a nature possessing little if any efficiency, or did they in disintegrating clog the wheel, the product would be much less valuable, if not worthless as an abrasive. The standard also contains about 10 per cent. of magnetic iron. It is hard to say how much iron can be used in a wheel without impairing its efficiency. Some wheel makers do not object in the least to the amount contained in the standard, claiming in their process it is an advantage by strengthening the wheel ; others complain bitterly. We made one series of tests which will illustrate the difficulty of determining to what extent magnetic iron affects the cutting of a wheel directly and indirectly.

From a keg of No. 34 standard corundum, weighing 300 pounds, we extracted the iron by a magnetic separator and made two wheels from the product, one of iron and one of corundum. The iron wheel proved a superior cutter on all metals on short tests. On long tests the tendency was to heat, with the usual results of glazing, etc. The explanation of the superior cutting ability of the iron grains, even for a short test, was due no doubt to the fact that no other impurity adheres to the corundum in the standard sizes except a very small per cent. of mica (chlorite), and that a piece of pure corundum containing a very minute particle of iron was attracted in the separating process. In all probability the percentage of corundum in the iron so attracted was fully 60 per cent.

My own opinion is that the presence of iron detracts greatly from the reliability of a corundum wheel, and shortens its life materially, for as the wheel disintegrates under pressure of the metal applied, the iron being retained on the wheel through heat and frictional magnetism, ultimately clogs the minute pores and heat follows rapidly, also heating the tool or metal applied, and the cutting gradually ceases ; the wheel must then be stopped and the dresser or diamond used to renew its cutting edges, and a loss of time and wheel material is the result. That some other impurities greatly detract from the efficiency of corundum, and the percentage of same, and the value of the product as an abrasive can only be determined by actual analysis and by comparative tests with the standard wheel. The following table is given as showing the principal abrasives in the relative order of their efficiency, when made into wheels and subjected to practical use, and it will be found to be approximately correct :

1. Diamond.
2. North Carolina corundum (Jackson County).
3. North Carolina and Georgia corundum (standard).
4. Chester, Mass., corundum (emery).
5. Turkish emery (best).
6. Bengal, or so-called India corundum, and a few other foreign emeries.
7. Naxos emery.
8. Peekskill (N. Y.) emery.
9. Garnet, best North Carolina, occurring in chlorite matrix.
10. Carborundum.
11. Preparations of crushed and chemically prepared steel grains.
12. Best flint, quartz crystal and ordinary garnet.
13. Common quartz, flint, buhr stones, sand, etc.

As the result of our tests, and of information previously acquired, I am not at all convinced that a wheel made of pulverized diamonds would do the rapid and continuous cutting that a pure corundum wheel will do ; like the product carborundum, it might prove in practical use of poor efficiency and economy. I have, however, until its rapid and continuous cutting capacity is disproved, placed it at the head in the list of abrasives.

I once took a large specimen of pure Georgia corundum (Acworth) to Fox Brothers, Maiden Lane, N. Y., to have sawed through, and in order to have the sides polished for a specimen. They at first stated they could cut it easily and named a low figure. On my returning for same they further stated they could only cut it at a great expense, that it had severely injured several diamond wheels and showed me the partially severed piece of corundum, which I still retain.

One can easily trace the work of each wheel, and where one wheel had cut a given distance it ceased cutting and began rubbing shoulders. Of course, they could have ultimately cut through, as the piece was but three inches square, but in order to have done so would have had to continually replace the old particles of diamond with fresh ones, which would in its results be precisely the same as with the product carborundum, which is manufactured from ordinary coke, and which, while practically a diamond, lacks the disintegrating properties so essential to rapid continuous cutting. It cuts in ordinary abrasive work with great rapidity for a few moments only, then, without dressing, the wheel practically ceases cutting. This can only be accounted for through failure of the particles of carborundum to disintegrate rapidly enough, and to thus present fresh cutting edges. I am of the opinion that corundum wheels, if properly made, of chemically pure corundum, may do all classes of heavy abrasive work better than wheels made of any other known substance, not even excepting the diamond, as its particles possess, in addition to great hardness, certain peculiar properties of disintegration so essential to rapid continuous cutting. Two well attested instances may be given as showing the great efficiency of a pure corundum wheel. Samuel Reynolds, Esq., an expert lapidary of Boston, Mass., in a few crucial tests made in 1874 to ascertain the relative cutting efficiency of North Carolina corundum when pure as against the gems of the Orient and the diamond, then stated to my father, "With one of your pure corundum wheels I have even cut the diamond." In a letter of 1890 to the writer, just prior to his death, my father says, "With a wheel made of perfectly pure sapphire corundum I have cut down a diamond rapidly."

In conclusion I wish to say it is not the purpose of this article to provoke controversy regarding the individual merits of abrasive wheels now upon the market, or to advocate any particular wheel ; this I have studiously refrained from doing, but it is with the hope that it may stimulate intelligent investigation and discussion of this subject, which will result in a more extended general knowledge of the application and value of the different abrasives and of their relative economy in the industrial world. CHARLES N. JENKS.

CHEAP ENJOYMENTS.

PEOPLE of cultivated tastes in art, music or literature are rendered so sensitive to false quantities that they may suffer more at times than the uncultured, but they have compensation in having opened to them a world of cheap enjoyment that is closed to those who have not been trained to see the beauties of nature, to appreciate the harmonies of sound or understand the imagery of the poet. The cheapest enjoyment comes, perhaps, to those who have had their sense of beauty cultivated. Nature spreads before them an ever-changing panorama of delightful scenes, and even in the cities built by men, picturesque scenes are presented to those who have eyes to see and imagination to project the view shorn of its surroundings. The man of cultivated taste finds at the seashore or in the mountains fresh beauties daily, while the uncultured native sees only a dull monotony ; the sea and sky always the sea and sky, the mountain always a mountain. It is not only the uncultured residents of places which attract tourists who are insensible to the charms of nature. A busy man of affairs who had never had time to look about complained of the monotony of the sea, which he was compelled to view daily during the fashionable season for the gratification of his family. Even as he spoke the lights and shadows were shifting, the waves were varying their hue in quick response to the movement of the clouds above them, and before his complaint had died upon his lips the panorama had changed its features. But he saw it not. To him sea and sky were the same as ever. He was shut out from the cheapest of enjoyments, one that may be had anywhere without price by those who have cultivated a sense of the beautiful and have learned to observe nature in all her varying moods.

Music and literature also afford cheap enjoyments to those who have been cultivated to appreciation of their higher forms. When far away from the sources of either, memory will recall them and they will yield fresh enjoyments without cost or effort. One may pick out from literature a host of familiars—friends who are always with us and never change—with whom to commune when alone, or about whom to talk when in congenial company. It may be that the uncultured find as much happiness in life as the well-read men of poetic and artistic tastes, but it is happiness of a lower order and less at command. It may also be that the cultured, by reason of their environment, find little happiness in this world, but they have at least acquired the means of enjoyment when they have had their sense of beauty developed and their minds illuminated by the good thoughts and merry conceits of the world's great writers. For this reason, if for no other, we should seek to educate our children in a broad way. While not neglecting their book studies, we should teach them habits of observation and cultivate their taste for art and literature. Disregarding any direct use that is to be made of such culture, it is a cheap means of enjoyment which they may carry with them through life. Such culture may serve to make the poorest rich, so far as enjoyment is concerned. Who has not known of families too poor to spend money on theaters, concerts and the like who have found equal pleasure in the home reading circle, in the study of the natural sciences or in the cultivation of a taste for art ? All parents have to look after the future welfare of their children, and the pressing importance of the means for their support turns attention to the studies that promise material returns ; but while not neglecting these we should all give some thought to means of mental culture, for this culture will afford them in after years the best as well as the cheapest means of enjoyment.—Baltimore Sun.

CATERING on an Atlantic liner, says the Caterer, is no light work. During the busy season the steamships carry hundreds of passengers, and then the edibles and drinkables consumed on a voyage are enormous. The average cost for provisions on a large liner is about £7,000 for the double voyage out to New York and back. The requisition for one such double voyage totals up as follows :

Beef (fresh and salt)	40,000 lb.
Mutton and lamb	6,500 lb.
Veal, pork, etc.	4,000 lb.
Fresh fish	4,000 lb.
Turtle	200 lb.
Turkeys	1,800 lb.
Fowls	2,500
Chickens	2,500
Ducks	2,000
Head of game	1,000
Rabbits	100
Eggs	25,000
Butter	2,200 lb.
Milk	2,000 gallons.
Oranges and lemons	20,000
Potatoes	25 tons.
Ice	50 tons.
Ice creams	700 quarts.
Wines and spirits	2,500 bottles.
Ale and porter	12,000 bottles.
Mineral waters	6,000 bottles.

SANITATION OF SHIPS.

AT the recent meeting of the Congress of the Sanitary Institute, held at Liverpool, Sir William Forwood presided over the section devoted to the sanitation of the passenger and mercantile marine service. In his inaugural address

Sir William Forwood said : The Council of the Sanitary Science Congress have very appropriately decided that special attention shall be directed at this meeting to the sanitation of ships of the mercantile marine, recognizing that in the port of Liverpool the great stream of emigration which flows toward the United States has its origin, and, therefore, that a conference on this subject, while it will throw light upon the sanitary conditions which at present prevail, may also lead to suggestions which may tend to their further improvement. The shipowners of Liverpool gladly welcome a discussion on this subject, for they have always been in the forefront in the adoption of every improvement likely to promote the health and comfort of the people in their employ, and of increasing the good name which Liverpool ships have always enjoyed with ocean travelers. In discussing the question of sanitation on shipboard, we must not forget that the conditions of sea life differ greatly from those of shore life. On shore three great physical essentials to sanitation—good drainage, pure water, and fresh air—are secured generally only imperfectly, and frequently with great difficulty, and even when secured their value is too often destroyed by the dirty, thriftless habits of the people. At sea these three great essentials to health can be obtained without difficulty, and the seaman and the emigrant being under command, their proper use can be secured without fail. We can only compare a ship at sea to a shore institution surrounded by a perfect system of drainage, with an abundant supply of good water, and situated on the hillside, open to all the winds of heaven, with the inmates under perfect discipline. It seems strange that with such conditions the question of the sanitation of our ships need be discussed, yet it is not many years since the forecastles of many of our merchant ships were a disgrace to our civilization.

Situated right in the bows of the ship, often not more than 4 ft. 6 in. to 5 ft. in height, cumbered up with the windlass, chain cables, and hawsers, flooded with water, which rushed through the hawse pipes every time the ship plunged into the sea ; destitute of sanitary conveniences of any kind, and filled with the hot, steamy atmosphere of bad tobacco and damp drying clothes, for which there was no escape, as there was no ventilation whatever ; no wonder that existence in such dens degraded the life of a seaman, and its baneful effects are still felt. In many modern ships the crews are comfortably quartered in a deck house, where they can keep dry and warm, and sanitary arrangements are provided in the shape of closets and washbasins, and in some ships baths are also to be found ; while the food of the sailor is no longer the dull monotony of salt pork and pea soup and salt beef and plum duff ; in well owned ships he is well fed with a generous allowance of fresh meat and vegetables. The condition of emigrant life on board one of the old fashioned sailing ships also left much to be desired ; huddled together as closely as they could be packed in steerages rarely over 6 ft. 6 in. in height, generally less, with only such light and ventilation as the narrow confined hatchways would afford, and at night lit by only a few miserable oil lamps which served only to make darkness more visible. On deck there was an absence of all shelter, and in bad weather the emigrant had only the choice of being drenched by the seas as they swept the deck or to be poisoned by the pestilential atmosphere of the 'tween decks ; the food supplied was of the scantiest description, inferior in quality, and badly cooked. To-day an emigrant in one of our great Atlantic steamers makes the voyage under sanitary conditions greatly superior to those he enjoys in his own home ; the steerages are lofty and well ventilated by movable cowls and electric fans, and abundantly lighted by large side ports by day and by the electric light by night ; the beds and bedding are scrupulously clean, the bedding is supplied by the shipowner, and is never used for a second voyage ; ample seat and table accommodation for meals is provided, and each compartment is furnished with a pantry and hot and cold water under the care of a special attendant ; on deck a spacious promenade is available to the emigrant under a shelter deck, where he can take exercise in all weathers ; the sanitary arrangements are excellent ; his food is well cooked and without stint as to quantity, and for his midday meal he has always

soup, fresh meat, and potatoes. Every morning, after breakfast, the emigrants are all sent on deck, while the steerage is thoroughly cleared and ventilated; and the captain and doctor at this hour make a personal inspection to see that everything is sweet and clean. I have been present at many of these inspections, and have been much struck with the cleanliness which prevails, and with the purity of the atmosphere. The ship doctor has ample hospital accommodation at his command, and is furnished with a complete dispensary and surgery. The sanitary condition of an emigrant ship very greatly depends upon the strict observance of rules as to cleanliness and ventilation; for this the captain and doctor are primarily responsible, and I attach the greatest value to the daily inspection made by these officers.

AN IMPROVED SAIL SYSTEM.

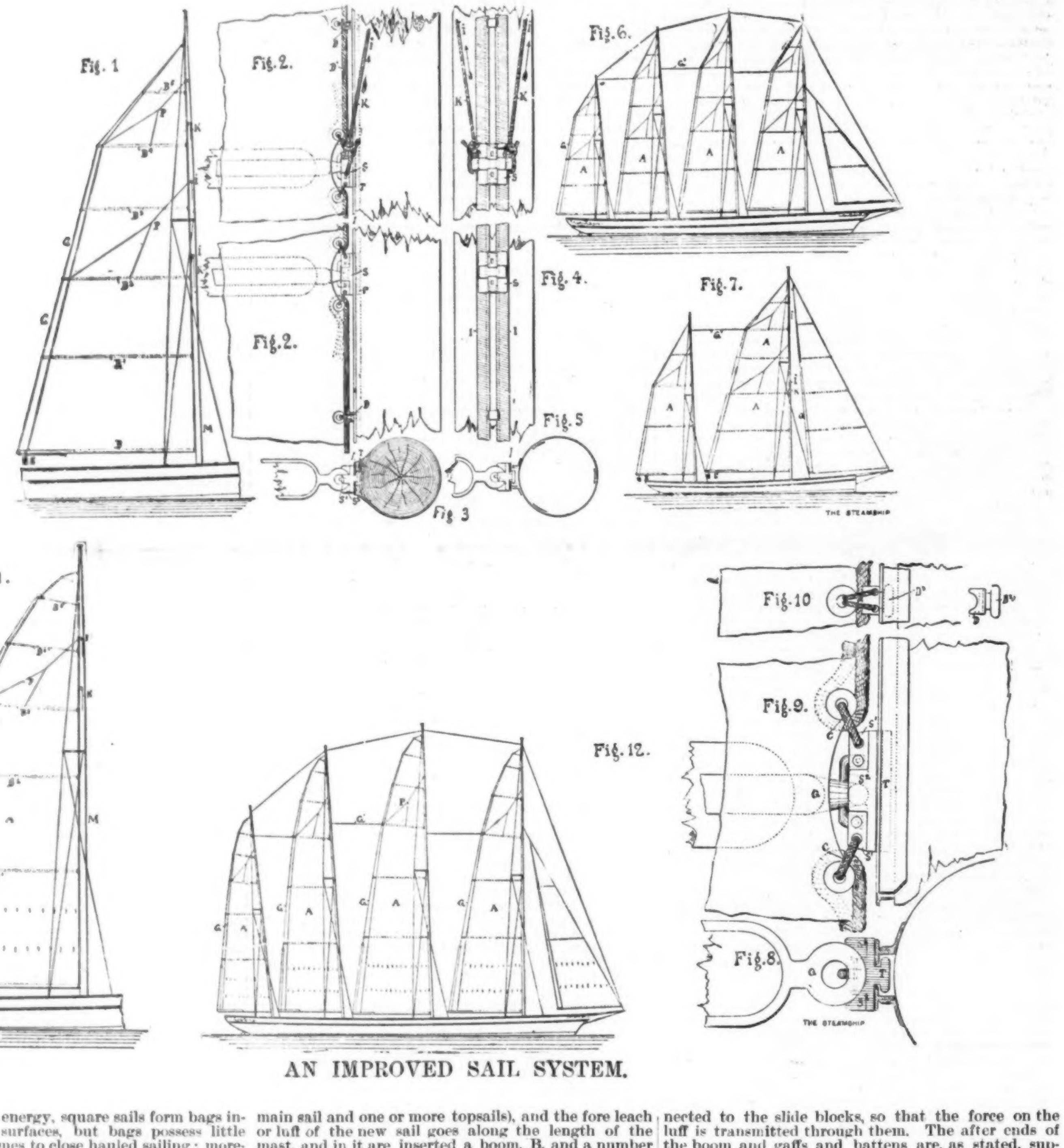
By H. C. VOGT, Copenhagen.

THE principal reasons why square sails possess so exceedingly little efficiency may be summarized as follows: When the wind increases, and nature is most liberal in bestowing energy, square sails form bags instead of propeller surfaces, but bags possess little efficiency when it comes to close hauled sailing; moreover they have a totally wrong shape, being short and broad, instead of long and narrow. A square sail is furthermore balanced instead of being unbalanced; sailors generally consider it a gain to work a balanced sail, and this is also the case when the wind is from the stern, but most sailors do not know that the very balancing of the sail makes it as inefficient as possible. It will be observed that the weather braces of a square sail are always taut sailing close hauled, and this is because the pressure of the wind is concentrated in less than one-third of the breadth of the sail from the weather leach. A square sail has therefore constantly a tendency to form a smaller angle with the diametrical plane, or turn the wrong way when sailing close hauled, and if free, it would put itself normally to the wind direction and drive the ship astern; but when the sail is unbalanced it yields a little under every increase in pressure and makes a somewhat greater angle with the diametrical plane, so that a better forward component is obtained in gusts of wind. It is therefore of importance for the sail to possess, as it were, automatic ability for turning the correct way, combined with a certain degree of elasticity, which requires that the sail be unbalanced; also, on account of the pressure of the wind being concentrated nearest the weather leach, it is of the highest importance that this part of the sail is supported by means of the mast, to prevent it from bagging and driving a-lee; in short the unbalanced sail is able to utilize much smaller angles of incidence and consequently insure much greater efficiency than the balanced sail. Without understanding the reasons for it, practical sailors are well acquainted with the enormous difference in efficiency between the unbalanced gaff sail and the balanced square sail; nobody would ever think of constructing a racing yacht with square sails.

After these general remarks I will now proceed to describe a sail system which has proved more efficient than those formerly in use. The results of the experiments and experiences lasting over eight months on board the gunboat Hauch, furnished with the new sail system, are however not published yet; so I shall only describe the system, which also in yachts has given higher efficiency than the ordinarily used rig. In the new system there is for each mast only one sail, A, as shown in Fig. 1 (instead of two or more, viz., main sail and one or more topsails), and the fore leach or luff of the new sail goes along the length of the mast, and in it are inserted a boom, B, and a number of gaffs and battens, B^1, B^2, B^3, B^4, B^5, etc., to the outheel sheaves of which the sail can be so hauled out that the force for holding the sail taut is distributed over the boom and gaffs and battens, instead of as in ordinary fore and aft sails merely by a boom below and a gaff above.

My construction also prevents the flapping or shaking of the sail when there is a light wind and a swell. As the speed of the wind increases from the surface of the water upward, the sail is similarly circumstanced as a propeller or a bird's wing meeting the fluid under increasing speed from the fulcrum upward and outward. The form should therefore be approximately the same, and the sail should form a propeller surface with the mast, M, as the leading edge or directrix, and the boom and gaffs and battens as generatrices for the sail formation. In order to hold the sail in place so that the luff does not fall to leeward of the mast, its after part is provided with two rails, I, Figs. 2 and 3 and 8 and 9; between these the sliding blocks, S, slide, and the luff of the sail is fastened to them; as the luff is thus kept straight, there is no need to strain the sail unduly, wherefore the sail will be rendered more durable. The ordinary construction with one rail may of course also be used.

Sails of this construction are therefore merely hauled up and are simultaneously taut, without being subjected to any further strain except from the wind. The after ends of the boom and gaffs and battens are supported by a kind of guy or vang, G, avoiding the necessity of the bolt rope in the sail along the after leach, so that the sail slips the wind so much better. Much labor is also saved because the mast, by reason of the form of the sail, takes most of the pressure, so that the power on the sheet becomes small. The detail side view, Fig. 2, horizontal section, Fig. 3, and end view, Fig. 4, and the enlarged sections, Figs. 8 and 9, show the gaffs and battens, B^1, B^2, etc., the fore ends of which are supported by the sliding blocks, S, which all slide on the rails, I. The slide block has two lugs, S^1, which take over and under and checks, S^2, fitting round the eye, Q, on the fore end of the boom and gaffs and battens, which are held to the side blocks by a shackle, but so that the boom and gaffs and battens are free to turn in all directions. The luff of the sail is, by means of lashings, C, as shown in Figs. 8 and 9, connected to the slide blocks, so that the force on the luff is transmitted through them. The after ends of the boom and gaffs and battens are, as stated, supported and carried by the guy or vang, G, which is fastened by means of seizings to eyes of the said battens and gaffs. Those battens which merely aid in holding the sail taut are very light, while the gaffs carried by the throat halyards, K, and peak halyards, P, are somewhat stiffer. The sail thus supported can be hoisted by several throat halyards, K, and peak halyards, P. From the slide blocks, S, to which the throat halyards, K, are fastened, and whereby consequently the fore ends of the gaffs are raised, the halyards pass over sheaves, i, on the sides of the mast, and then down to the deck. The peak halyards, P (by preference double, having a part on each side of the sail), also lead from the outer end of the gaff over sheaves, i, on the side of the mast, and thence to the deck. Peak halyards should always be well hauled, in order, in combination with the guy or vang, G, to spare the sail and carry the weight of the battens. The small slides, also shown in Fig. 10, consist of a back piece, D, to which the bolt rope, D^1, is united, and a front piece, D^2, working inside the rails. The stem connecting these pieces is cylindrical, and can turn freely between the rails, so that the sail can



AN IMPROVED SAIL SYSTEM.

fold up. The system herein described may be reefed from below or from above. When reefing from below, the whole sail is pulled a distance down, and the vang, G, is simultaneously hauled upon, so that the sail is shortened, while the unreefed part of the sail yet remains taut, because of the rails and the gaffs and battens, so that the course may be steered and the lower loose part of the sail be made fast to the boom, B. If the sail is to be taken in very quickly it should be done from above, and nothing is needed but to cast loose the uppermost halyard or halyards, and by means of downhauls to haul as large a part of the sail as desired down to a gaff provided with throat halyard and peak halyard, and if the latter is double, the reefed part of the sail will lie steady between them. Peak halyards, which should be well hauled, will then, in connection with the guy or vang, G, take the whole strain to keep the sail to the wind. The reefing of a sail is, of course, a matter of the highest importance, and ordinary gaff sails, when large, become generally unhandy under the process of reefing, whereas this sail, by means of the gaffs and battens in the sail, supported at their one end by the rails and at their other end by means of the guy, G, are perfectly under control, and just by means of the said guy under a similar control as yards, whereas still the enormous gain in efficiency attached to the unbalanced sail, with the mast as the leading and supporting edge, is preserved, as well as a proper and correct shape. It is well that this sail shall be hoisted up and down with the battens and gaffs in the position which they assume when the sail is taut, or, in other words, in a parallel position. The mast in this system should be in one piece from deck to truck.

The rails, I, may, as shown, be screwed fast to longitudinal chocks or flanges, if the mast is of wood; if the mast is of steel, angular or T-shaped rails may be fixed to the same by means of angle pieces at certain intervals.

The steadying of the mast is in this system increased by one or more cross-trees, as shown in Figs. 1, 6, 7, 11, 12, the shrouds from the top being carried out over the cross-trees and then to the ship's side. It should be noted that the hoisting of the sail along the rails from the foot of the mast to the top of same in nowise hinders the staying of the mast, which is a very important point. One of the shrouds may be carried over the end of the cross-tree forward, so that it will act as a fore stay; the cross-trees themselves should also be linked or jointed toward the mast, so as to be movable. As the distance between the sails ought to be equal to the width of the sails, in order that one may not interfere with the action of the other, there is nothing to prevent stays being carried direct forward, but the gaffs will, because of the guy or vang, G, exert forward pressure, so that staying in that direction is not much needed.

A line, G^1, Figs. 6 and 7, may, if desired, be added from one of the gaffs to the mast abaft of same, and be made use of by hauling upon it when turning before the wind. There is, however, by means of the gaffs and battens and the guy, G, good control over the sails. When sailing before the wind the fore and aft sails may, as usual, be thrown out to each side; square sails and the like may also be hoisted in that case. It is not difficult to make way when the wind is aft, but it is the close hauled sailing upon which all depends to avoid strandings, etc. As a matter of minor importance, it may also be remarked that springs, E, under the boom, B, Fig. 1, may be made use of as a kind of accumulators.

Steamers, because of their own propulsion, have seldom any use of wind from the aft, but with beam wind or close hauled they may, if correctly rigged, make use of the wind, even if their speed be as high as that of an ice-boat or as the periphery speed of a wind sail. The wind power has for thousands of years been found good enough to drive that most important of all means of communication, namely, the sailing ship, and even at the present day the sailing ship keeps up its head, although so very uncorrectly rigged. Steamers despise the wind power, but the sole reason is that their rig is totally unsuitable for utilizing it. With a correct rig it would be found, as also remarked by Mr. White, that the use of sails increases the efficiency of the screw propeller, because the well known augment in resistance caused by the screw propeller is diminished, as well as the friction in the thrust block, etc., conversely does the propeller increase the efficiency of the sails with beam wind and close hauled. A correct sail system saves an enormous amount of coal, as also proved on the Danish gunboat Hauch. Hoisting and maneuvering of the sails should, of course, be effected by steam power. The steam engine should, in fact, play the part of a strong man used for working the sails as well as for driving the propeller, and the present sail system is especially adapted for the use of steam power. An economical ship is not a sailing ship with auxiliary steam power, because steam should always be up and ready for use, which also is essential for keeping the engine in good order. But an economical ship would be found in a steamer with a correct rig. The steam power in such a ship should just be sufficient to drive her six or seven knots in a calm, but the propeller should almost constantly be at work, and the rig sufficient to drive her 12 knots with fair winds, even four points from the wind, when sails and propeller are working together (the propeller for this purpose having great pitch). In a moderate breeze the sails in the gunboat Hauch, though small in comparison with the hull, are able to deliver 70 per cent. of the work necessary to drive the ship seven knots, even four points from the wind, the remainder, or 30 per cent. of the work, being yielded by the propeller.—The Steamship.

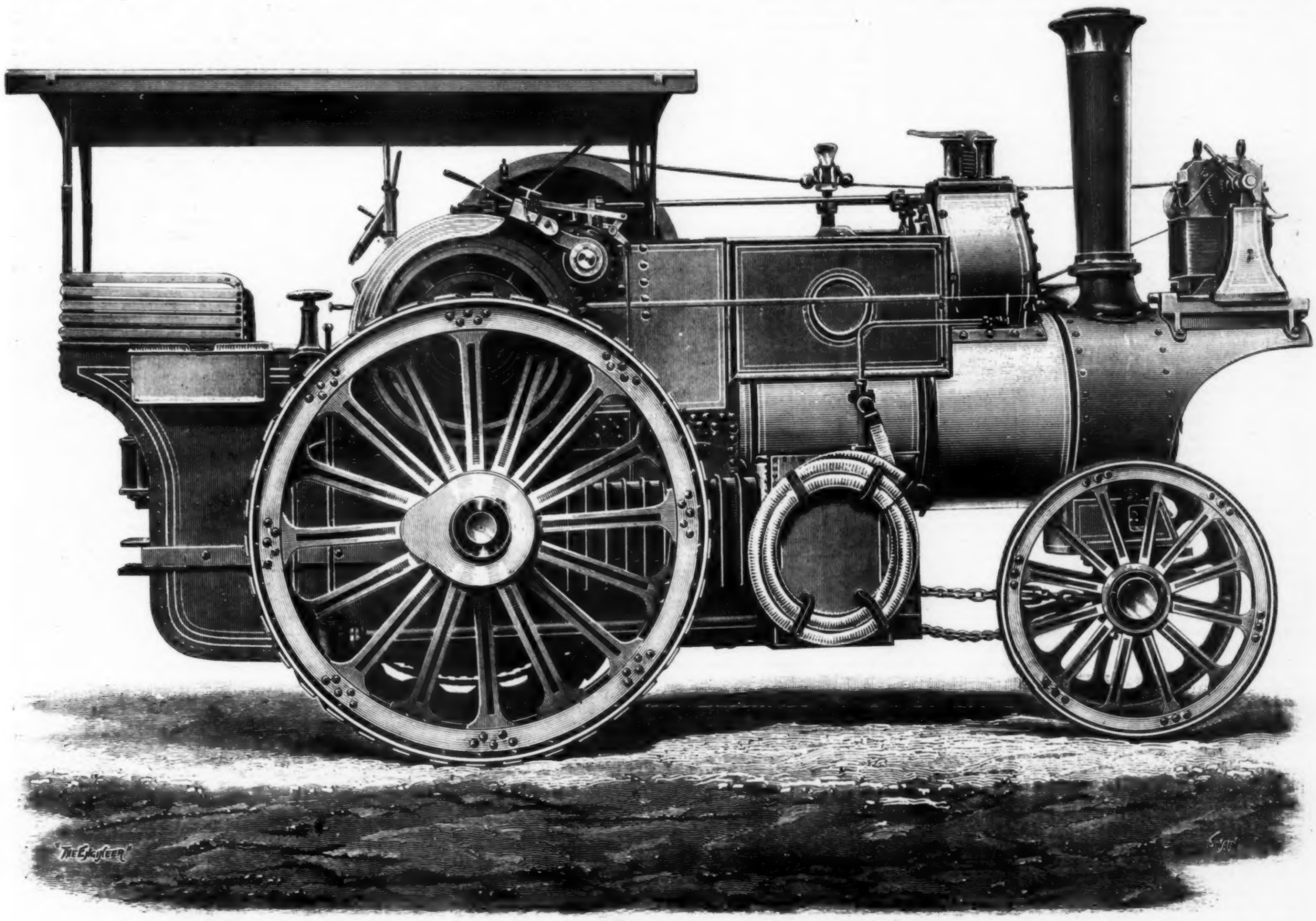
As a result of the recent tests at Newport, the Small Arm Board has recommended that the Ruger gun be adopted for the naval service. The invention differs materially from the guns previously tested. The Ruger gun is of the rotary bolt pattern with a central under-receiver magazine. It has a caliber of five mm. and is used with rimless cartridges. The tests showed that the gun had several serious defects, but that it was superior to any other gun offered.

TEN HORSE POWER COMPOUND TRACTION ENGINE.

Few of our readers are aware of the expense incurred by the proprietors of traveling merry-go-rounds in the purchase of their plants. The quantity of stuff to be frequently moved is very large. Thus, "Hancock's Great West of England Steam Switchback" requires five immense road wagons for its conveyance from place to place. The proprietors of these shows have found that it is very much cheaper to employ steam than horses to do the hauling, and they regard the traction engine as an important feature in their display. Messrs. Charles Burrell & Sons, of Thetford, have supplied several traction engines of this kind, the finish of which is as good as it possibly can be made. As these engines have to work through all kinds of hilly country, they must be excellent. Thus on one occasion a run was made from Poole to Weymouth with a heavy load, and the thirty miles were covered in eight hours, or, excluding stoppage for dinners, seven hours and a half. Starting from Poole at 8 A.M. the engine arrived at Weymouth Esplanade at 4 P.M.

Messrs. Hancock Brothers, of Bristol, purchased an eight horse power engine at the Doncaster Show in 1891 from Messrs. Burrell, and that which we illustrate has recently been delivered to the same firm.

Messrs. Burrell's system of compounding consists in using one crosshead for the two piston rods, and consequently we need not go over old ground. The new engine was specially built to order. The dimensions of the ten horse power engine are as follows: Diameter of cylinders, 7 in. and 11½ in. by 12 in. stroke; driving wheel, 6 ft. 6 in. diameter by 18 in. wide; front wheels, 4 ft. 1½ in. diameter by 12 in. wide; hind tank holds 178 gallons; front tank holds 125 gallons. The engine is exceedingly strong. The working pressure is 150 lb., and the finish is in all respects equal to that of a first-class railway locomotive.—The Engineer, London.



TEN HORSE POWER COMPOUND TRACTION ENGINE.

MEASURING THE SENSES.

A writer in the New York Sun says: Everybody knows how easily children in general take up a suggestion, and what curious exceptions to the rule there are. One little girl will believe everything you tell her without question, and will imagine she sees or feels anything that the teacher suggests to her. Another child will persistently doubt the teacher's word, will be a skeptic on all questions, and if he grows up to be a philosopher, will probably doubt the evidence of his own senses. It is to measure this difference of suggestibility that Prof. E. W. Scripture, of Yale University, has been conducting a series of interesting experiments. Prof. Scripture gives the following account of the process:

"Here is the way in which it can be done. Through a thin wire I send an electric current just strong enough to make the wire slightly warm. I ask some one to put his finger on the wire before I send the current through, and taking out my watch, I note the second at which I send it through. He is to tell me

when he feels the slightest warmth, and I note how many seconds pass before he feels it. Then I perform the test twice again, and note the time as before. I hold the connecting cords in my hand, and the current can pass only when the two points touch. On the last two tests I do not let the points touch, and so the wire does not in reality become hot at all, and the sensation which the person had was the result of my suggestion that the wire was going to be hot. The time it takes for that suggestion to work will give some idea of the person's suggestibility.

"Last year experiments were made on about 1,400 children in the public schools of New Haven. They were done under the supervision of Dr. J. A. Gilbert, of the Yale laboratory, and are reported in 'Studies from the Yale Psychological Laboratory.' As experiments with the thermo-suggester cannot be performed rapidly enough, a set of suggestion weights was devised. It consists of a large block (D) of wood and a small block (d) filled with lead. Both of these blocks are exactly equal in weight. When a person lifts first one and then the other of these blocks between thumb and finger it is impossible to believe that they are of equal weight, even if he knows the fact. The eye suggests that the big block must be heavier, because all our lives we find big things to be heavier than little ones. But when the hand raises them we are surprised not to find this the case with the blocks, and the discrepancy at once suggests that the small block is heavier. It is a fact that after a year's familiarity with these blocks and after having many times weighed them on the scales I cannot undeceive myself. Even to-day the small block actually feels the heavier.

"In the new psychology we are not contented till we can measure everything. The question arises, How much heavier does d seem than D? The answer gives the effect of the suggestion of size on the feeling of weight. To obtain the measurement, a set of blocks, all of the same size, are used. One of the blocks of this set is of the same weight as the blocks, D and d; the others are successively lighter or heavier. Suppose this set of middle sized blocks varied in weight from 15 ounces up to 80 ounces, and that the blocks, D and d, weighed 55 ounces. Then you first pick out the middle-sized block that seems to be equal in weight to D, say, for example, the 25 ounce block. Then you pick out the one equal to d, say the 70 ounce block. Now we have caught you. D and d are exactly alike, yet you make a difference of 45 ounces in weight between them.

"When the experiments were made on the children nothing was said but 'Pick out the middle-sized block that is of the same weight as the large block; pick out the middle-sized block of the same weight as the small one.' The children did not suspect that D and d were alike. In this way we obtained an unbiased measurement of the influence of the size of a thing on the child's judgment of its weight.

"As in all scientific work (and in all civilized communities except the United States), the metric system of weights is used. Our blocks were weighed in grammes. An ounce is equal to 28 grammes. The blocks, D and d, actually weighed 55 grammes, and the middle-sized blocks ranged from 15 to 80 grammes. About 100 children of each age from 6 to 17 were taken. The average effect of the suggestion was as follows: 6 years, 42 grammes; 7 years, 45 grammes; 8 years, 48 grammes; 9 years, 50 grammes; 10 years, 44 grammes; 11 and 12 years, 40 grammes; 13 years, 38 grammes; 14 to 16 years, 35 grammes; 17 years, 27 grammes. For all ages the average was above 25 grammes. The suggestibility slowly increases from 6 years to 9 years; after 9 years it steadily decreases as the children grow older. The results, when separately calculated for boys and girls, show that at all ages the girls are more susceptible to suggestion than the boys, with the exception of the age 9, where both were extremely susceptible.

"These are the average results for large numbers of children. Many young people, however, were so susceptible that our set of middle sized blocks did not range far enough to suit them. At the age of seven years 37 per cent. of the children declared that the large block was lighter than the lightest block, and that the small block was heavier than the heaviest. The actual difference between them was 65 grammes; thus the effect of suggestion was more than the weight of the suggesting blocks, D and d.

"Thus we have gathered a few facts on the susceptibility of children. The full significance of suggestibility is apparent when we remember that teaching, preaching, acting, public speaking and pleading are forms of suggesting. The freaks of hypnotism are performed by suggestion. The faith cures and the miraculous effects of the grotto of Lourdes are benevolent suggestions. The ceremonials of our churches are suggestions bringing us into a religious frame of mind. The manipulations of the spiritualists and the monotonous blackness of a funeral are all forms of suggestion. How shall we develop the children so as to produce in them minds well balanced in respect to suggestion? Is this not as important a task as learning to do percentage or to parse a sentence? Here is a field where the educator must dig for facts."

HALLUCINATIONS AND DELUSIONS.*

By WM. M. McLAURY, M.D., New York City.

I WANT to bring before the Academy of Anthropology a short paper on mind in some of its peculiarities and phases of development. Man, in his entirety, is a unit, as body and soul is dual, as body, soul and spirit is triune.

We all know something of man as a body, as a physical body comprised as a body, composed of organs, capabilities and powers. As a soul, we are taught that he is immortal. All our knowledge of the immortal man is derived chiefly from writers known as inspirational, who define the soul as an immortal being.

If the soul has no end, it had no beginning. It is a law of mathematics that whatever has a beginning has an end. Everything conceivable, except a mathematical point, has a beginning and an end, and a continuity between the beginning and the end, thus constituting everything triune in character. So we must conclude that, if the soul is immortal, it existed in some form previous to its habitation in the body. Mind, or spirit, is the personification of characteristics of soul, as manifested in our emotions, affections, powers of mind, comprehension, reason, will power, attention, memory, and all the faculties capable of cultivation through our intelligence.

Life, or force, is universal. It pervades everything. It is the property of all matter. It is electric in its nature and polar in its influences. All force is electric and all matter magnetic It is a component part of the trinity of nature, that trinity being matter, force and law.

As Avero expresses it, "It sleeps in the rocks, dreams in the animal and awakes in man."

There can be no matter without soul or force, and no soul or force without matter. They are co-existent and co-eternal, and the law governing all is the only deific power.

All passions, fixed ideas, preoccupation of thoughts, may induce hallucination, more especially if the pensive thoughts are intensely fixed on the passions of love, fear or remorse.

Dr. Brewster says that when the eye is not exposed to the impressions of external objects, or when insensible to the objects in consequence of being engrossed with its own operations, any object of mental contemplation, which has either been called up in the memory or created by the imagination, will be seen as distinctly as if it had been formed from the vision of the real object.

An individual who believes he sees supernatural sights can easily persuade others to see or believe they see them also.

Imitation is a powerful agent in the production and propagation of delusions. Example proves contagious. For instance, a man stood intently gazing at a statue. Soon a crowd collected. He strenuously and earnestly asserted that he saw the head of the statue move or nod, and in a few moments a score of people were sure they saw it nod.

Lawyers are well aware of the art of manufacturing evidence, coaching a witness, by repeatedly telling him or her that they saw or heard a certain act or conversation. The subject so receiving the suggestion, repeatedly and emphatically stated to them, will come to believe that he really saw and heard, and will so testify in court, whereas, in fact, the only knowledge the witness had was what was built up in the testifier's mind by suggestion.

A person may also tell an untruth which he knows to be untrue at the start, but by repeatedly telling it, come to believe it true in time. Thus many persons have confessed to the perpetration of crimes which they never committed, but by pensively dwelling on them in detail, have come to believe themselves really guilty. One can easily build up an idea in the mind of a child so as to make a most vivid reality. Evidence in divorce cases has been and still is being built up, by designing parents, in the minds of their own children, so that they will testify that they saw and heard certain things, utterly false, but which, by suggestion, they believe to be true.

Dr. H. F. Drayton, in his work on Human Magnetism, says that there can be no doubt that much evil has been consummated by the employment of magnetized victims, and these poor victims have in some cases borne the punishment of broken laws, while the doubly villainous principal has escaped. The medico-legal records of France contain cases of shocking immorality, in which the perpetrators of the crime were incited to it by hypnotic suggestion.

It is just as practicable to induce people to state things that they have never heard, commit perjury, or swear falsely, being made to believe that what they say is true, also by suggestion.

Bottey convinced a woman that she had seen a certain gentleman poison an old lady with opium, and when she awoke she hastened to the proper officer to make the accusation against this man.

The fact should be noted as a dangerous feature that the hypnotized person does not, on awaking, remember the cause of suggestion, or from whom he received it, but in a judicial inquiry concerning the act, of one known to be susceptible, the ends of justice may be promoted by obtaining testimony from him while in a state of hypnotism, since the memory of what has occurred while in one state of hypnotism revives in the next. However, it must be stated that the hypnotizer can neutralize even this tendency to revival by an order that the subject shall forget entirely all that was said or done when under control.

The phenomena of Salem witchcraft, as also the epidemics of swoons and trance, may be scientifically accounted for by the hypnotism so frequently met with to-day. People are hypnotized without knowing it.

Napoleon Bonaparte believed in a luck star and consulted oracles.

General Rapp relates that, going one night unannounced into Napoleon's tent, he found him in so profound a reverie that his entrance was unnoticed. After some time the emperor turned around, and without any preamble, seized General Rapp by the arm, saying excitedly, pointing up to the sky, "Do you see that?" The general did not reply, but on the question being repeated, said he saw nothing. "What!" replied the emperor, "you cannot see it! It is my star! It is shining there before you! It has never abandoned me! I see it on all great occasions! It orders me to go forward! It is a constant sign of good fortune!"

Of Cromwell, Denby relates that on one occasion he was lying on his bed very much fatigued, when the curtains were drawn aside and a woman of gigantic stature appeared to him and prophesied his future greatness.

Bodin relates the hallucinated condition of a friend of his, in which touch, sight and hearing were involved. In the beginning he heard rappings at his door, after which time, whenever he was about to do anything dangerous or improper, he felt a touch on his right ear, and if what he was about to do was to be to his advantage, the touch was on his left ear. On one occasion he saw on his bed an apparition of a child of marvelous beauty, clothed in white and purple. Soon afterward he had a wonderful deliverance from imminent danger.

Guy Patin shrewdly suspects this was Bodin's own personal experience.

In 1890 I had a patient, a man of 33, unmarried, American, of Irish parentage, who had hallucinations and illusions somewhat remarkable. In the daytime, when wide awake, he would have visions of friends, acquaintances and relatives, with multitudes of unknown people, constantly passing before his vision, but with a cloudy indistinctness, much more bulky and giant-like than the natural people; but in the midst of this vision, which would last for hours, he said I was always vividly distinct, and in proper form and shape. Sometimes he could distinctly hear my voice. Then the illusion would disappear.

After these visions had haunted him for several weeks he began to see the doctor (myself), and some one he called the poet. Both appeared clear and distinct. A few weeks later, three people appeared to look natural to him, but with painful distinctness. These three he described as the Doctor, the Poet, and the Clog Dancer. The crowds of other people constantly before him were large, vapory and indistinct.

In April he wished me to send him to an insane asylum, fearing he would commit suicide if he was not placed under restraint. I told him he was not insane enough to be committed to the insane asylum, that all he required was to apply himself diligently, at regular hours, to his business, which was that of selling goods on commission.

After repeated solicitations for me to send him somewhere to protect him against himself, I sent him to Dr. Cole, a commissioner of lunacy, who examined him thoroughly. We went before a court of record and had the papers duly administered for his commitment, but before this was done he had improved somewhat and was willing to be guided by me. I advised him not to enter the asylum, assuring him that if he entered he would never come out alive. He was in the habit of coming to see me daily, or three or four times a week, and always claimed that it did him good every time he called on me.

The last time I saw him was October 8, 1890, when I told him I would be away from the city for ten days. He assured me he could not live ten days without seeing me, saying that it was only my influence over him that had kept him alive the last six years; but if he wished to, I told him to call and see my assistant. He did not call. I have had no word from him since, and I fear he has committed suicide, or perpetrated some act for which he has been arrested. I find no record of him anywhere in any of the institutions in which he would be likely to be found

November 22, 1890. To-day I saw a patient who was hallucinated with the idea that people, strangers to her, visit her rooms, scratch the walls, and leave imprints of their hands and feet thereon.

Her sister, who is a religious monomaniac, says that it is because Kate has no religion that she is so persecuted by evil apparitions. The simple truth is, both sisters have insane delusions, but each differing in character, Annie, the religious devotee, being the more melancholy and miserable of the two.

A patient of mine related to me the hallucination he was under, that certain persons, nurses and doctors, were trying to kill him, and that he was compelled to fight them off to save his own life. He was now convinced that it was all a misconception, but painfully real to him then.

It is this class of cases that give so much trouble to nurses and keepers of insane asylums, which so frequently call for investigations for the correction of abuses therein. This patient died of cerebral apoplexy September 14, 1891. I have now under treatment an accomplished lady who tells me she hears daily, for hours at a time, sweet, rapturous vocal music, but it is so prolonged and continuous that it becomes tiresome.

Many persons become hallucinated with the idea that they hear human voices talking to them, exclaiming vehemently, advising, denouncing and threatening.

Socrates told the Athenians that he was continually influenced to heroic actions and good deeds by a demon. (There were good and evil demons in those times.) These influences to do good were attended by no voice, but he was restrained from evil and danger by a voice. This warning voice was never passed unheeded by him. By strictly observing and attending to the instruction and influence of the voiceless good demon, he could so influence his friends and pupils, and even strangers, as to compel them to do his bidding (independent of word or look) at a distance, or when separated by walls. In the phraseology of to-day, he possessed the power of hypnotizing by thought transference. He also had ecstasies and hallucinations, and some faith in dreams. (From these circumstances M. Lelut concluded that he was insane.) He believed also in the prophetic power of the human soul.

Cogito, ergo sum!—the motto of the philosopher Descartes. The power to think and think rightly sanely embraced the total of human existence. He said all clear ideas are true. Hence he elaborated his mathematical or deductive method. B. Spinoza elaborated and exemplified this philosophy.

Nations as well as individuals became infatuated and deluded.

Christian nations look upon the Mohammedans as the victims of a stupendous delusion.

The followers of Islam are sure that Christians and Jews are deluded. Indeed, all sects who are bound individually to each other by dogmas or creeds, each one is assured that all the rest are misled and bound by their delusions, and inasmuch as all are superstitious, they give better judgment on the faith of others than on their own. The only class of individuals who are free from superstitious delusions are the philosophers who are searching for truth for truth's sake, and are willing to follow where she leads, even to blank materialism.

Church people look upon modern spiritualism as a delusion, yet they are very ready to believe in Bible spiritualism, which philosophers would accept or reject, one or both, according to the amount of rational evidence either might be able to produce.

Such Bible teaching as "the handwriting on the wall," at Belshazzar's feast, and "the transfiguration on the mount," with several other incidents of like import, would at once be recognized as material manifestations of spirit power, as claimed by modern spiritualists, and may occur in our day and generation as truly as in Bible times.

Since the time that Herodotus, the father of history, began to write, we have in every generation manifes-

* Read before the New York Academy of Anthropology.—From the Alienist and Neurologist.

tations of spirit presence and power recorded, under various names and in all countries.

Hypnotized subjects lose their will power, because they are dominated by the thought, will and suggestion of another, and they cannot rise higher in moral sentiment than that which actuates or inspires the hypnotizer.

Inasmuch as persons of rare acquirements, good mind and intellect may be held under the hypnotic influence of persons every way inferior to them and without their being aware that they are so influenced, is to be deplored by every one devoted to the welfare and development of our race. I believe from my own observation of cases, persons may become insane or idiotic by the persistence of the hypnotic suggestion.

Dr. Rush relates the case of a young lady who had been for some time confined in a lunatic asylum whose only indication of insanity was indifference and even hatred to her parents, whom she had previously devotedly loved.

At length she one day acknowledged with pleasure her filial attachment and was soon afterward discharged, entirely recovered.

There is a great variety in the manner and degree to which the mind is influenced by hypnotism and other extraneous and erroneous impressions. In many cases it effectually changes the whole character of the individual. Its general tendency is to lower the moral tone. Accustomed occupations become odious; the nearest and dearest friends become objects of indifference or aversion.

Abercrombie relates the case of a wealthy man who became hallucinated with a matter of business, of a trifling nature, which rendered him callous to the most important and serious incidents, destroying his affection for his family. The death of one of his children occurring at the time did not affect him or depress him in the slightest degree.

Those who were present on the evening of February 3, and listened to the very interesting and instructive paper on "Phrenology and the Physician," by our esteemed ex-secretary, Dr. Laidlaw, may recall the remarks of Prof. Nelson Sizer, in discussing Dr. Laidlaw's paper, where he related the complete recovery of cases of many years' duration, as well as recent ones, by the local treatment of the areas of the brain.

Doctors and others familiar with people suffering from delusions and hallucinations know that for twelve, fifteen or twenty years they will harp on the one subject in their delusion, and be fairly natural on other subjects. Prof. Sizer would point out the brain area to be treated by the phrenological action, of the particular mental condition of the patient.

A captain in one of the regiments serving in the war of the Rebellion, who was for several weeks a prisoner at Andersonville, returned home at the close of the war with shattered health. A few years later he became hallucinated with the idea that he had committed the "unpardonable sin." This so depressed him that eventually his friends were compelled to send him to an insane asylum, where I visited a few weeks later.

The first time I saw him there, one of his sisters was with him. As I entered, he exclaimed with excited voice and manner: "Well, if there isn't the ghost of Dr. McLaury!" I replied, "Why do you call me a ghost, captain? You may assure yourself that I am something more real than a ghost." His reply was: "Well, you know I died at such a time (mentioning about the time he was committed), and as I had repeatedly told you that I had committed the 'unpardonable sin,' and at death should immediately pass into hell. Now I know I am not in hell—I am sure I am not in heaven—I cannot tell where I am, but I know that the ghosts of my earthly friends appear to me. This is the first time that you have appeared, but my sisters and masonic friends frequently appear, but whether you are Dr. McLaury really, or a ghost, I want a little private conversation with you."

This patient recovered suddenly, to the surprise of all the doctors who saw him. I have now under observation a member of the legal profession, who is continually annoyed by people trying to electrify him. He fancies he hears them in the walls and ceilings of his house; they are continually plotting his ruin, and that of his family. He frequently calls his sisters in the middle of the night, to help him to resist their evil machinations. I have scores of letters that he has written to me on this subject.

HE'S BLOWN TO PIECES FREQUENTLY—A MAN WHO THINKS HIS BODY IS PIERCED WITH ELECTRIC WIRES.

The man in the Hudson County Insane Asylum who was afflicted with the idea that he had a telephone in his stomach, now thinks he is being tortured with electric batteries. This man was a telephone crank before the first telephone was put in use. It has been his hobby for a year or more. He began to hear voices talking to him wherever he went. Soon after the first telephone came into use he visited a place where there was one to experiment with. The instant he heard a real voice through the transmitter he became violently insane. He smashed the instrument to pieces. He was taken to the Hudson County Asylum in a straight jacket, and has been there ever since. He was one of the curiosities of the asylum. He talked rationally on any subject that visitors chose to talk about, but right in the middle of his conversation, without any warning, he would exclaim:

"There's that fellow again, dang it all. Hello! hello! down there; what's wanted? Now just hear him ring that bell, as though I didn't hear and answer him. Hello! I say, down there, hello! Well, if he won't answer, let him go."

Then he would resume conversation just where he left off. Sometimes he would think the imaginary voice answered him and would carry on a long conversation with him, always at the end complaining of the rumpus the fellow created in his stomach.

The officials of the asylum don't know what caused him to change his delusion. It was done suddenly. One day recently, when the doctor talked with him, he said: "This is awful, doctor. Those batteries down stairs have got to be taken out. They are killing me." The doctor asked him for an explanation, and he said that a lot of batteries had been put in the cellar, and that wires running from them went right through his body. "Then they turned them on!" he exclaimed, and began to dance up and down and shout and cry out in apparent agony. At last he gave an extraordinary loud shout, and his arms and legs flew out and about in every direction.

He explained afterward that he had been blown to pieces by the electricity. At intervals ever since then he has had similar spells which very often ended in his blowing to pieces. He acts and talks rationally nearly all the time. In the midst of one of these spells one day the doctor said to him: "You are only fooling yourself. There is no battery and no electric machinery in the cellar. Come with me and I will show you."

The man accompanied him gladly. The cellar was searched thoroughly. When the search was concluded the man turned to the doctor and said: "You are a foxy doctor, ain't you? You knew you would bring me down here, so you had it all taken away to fool me, but you can't do it." The doctor went back up stairs with him. At the head of the stairs the man said: "There, you pressed the button and it's back again. You don't dare take me down now."

There are many cases recorded of cures being effected, as well as insanity caused, by accidental blows on the head.

Dewes cites a case of a man who left his house at night with the determination of drowning himself, when he was attacked by robbers. He did his best to escape from them, and having done so, returned to his home with his suicidal ideas entirely dissipated.

Dr. Burrows mentions a similar case of a woman in the act of attempting suicide. An accidental blow on her head changed her purpose and restored her to reason.

A man who was greatly fatigued by a long journey on horseback, and suffering severely from headache, concluded he would have to abandon his purpose of reaching his home, ten miles distant, without taking a much needed rest. While in this mood of giving up he was suddenly pursued by highwaymen. He urged his horse and escaped them, and when the danger was passed, rode the remainder of the way without weariness or headache.

Last August I attended at one of the hotels in this city the wife of a hotel keeper at Galveston, Texas. They were on a visit of pleasure to New York. The lady was ill before leaving home, and became very sick the second day after their arrival. In ten days she had so improved that they returned to their Southern home.

I had a letter from her husband a few days ago, informing me that she had kept up the treatment for a month and that she has never been so well since he knew her as since her return, but she has no distinct recollection of anything of her visit to New York but my attendance, daily visits and treatment. All that she remembers distinctly to the minutest detail, and now she wishes to return and complete her visit.

A lady, 30 years of age, suffering from a fatal illness, told her nurse shortly before death that Dr. McLaury had deserted her and sent another doctor to take charge of her. This doctor, she said, was going to shoot her dead. She was sure of it, as she distinctly saw the pistol under his coat.

My friend Dr. J. L. Campbell, of this city, had a patient belonging to a wealthy family, who was preparing to celebrate her 17th birthday. They were making extensive preparations, and she was in a high state of pleasurable excitement in her anticipations.

On the morning of the festive day she slept so profoundly that she could not be aroused, and for several days seemed most of the time asleep. When she did partially awake, she remembered nothing of all her past life, was dull, stupid, and almost idiotic. Her parents employed all the medical skill that wealth could procure, in her behalf, but she did not improve until nearly four years later, when she was under no special treatment, she awoke on a Sunday morning bright and early, perfectly clear and lucid, sprang out of bed, and commenced preparations for the party, where she had left off three or four years before, and wondered at the indifference of her family in regard to her birthday.

I believe she continues well. I can only account for these cases of sudden recovery on the theory that there is an impediment or clogging of some portion of the brain. It was probably blood clot, which was suddenly absorbed, or sluiced, leaving the brain clear, active, and in its normal condition.

(To be continued.)

HISTORY OF SODA WATER.

MOST chemists, probably misguided by the piquant taste of certain mineral waters, as it is in seltzers, thought they were acid, and through this erroneous opinion they were called and known as acidulated waters, a peculiar name given to the waters of Spa, seltzers and others. After this, Hale, who committed the same error, Frederic Hoffmann and Slare thought that they had discovered an alkaline principle in these so-called acidulated waters, and thereafter these two scientists had many exciting and hot arguments to whom of the two the honor of having made the discovery should be attributed.

According to another chemist, Duchanoy, the most difficult part in this case was to prove by an experimental process that the gaseous fluid which escapes from an alkali after an acid has been added to it, is the same one that mineralizes the acidulated water. The discovery, the above named author says, can be found entire in the works of Hoffmann, published in 1740.

But according to our views Duchanoy advances more than the mentioned texts of Hoffmann can possibly justify. If an alkali is put in a bottle filled with water and provided with a small neck, and some oil of vitriol is added to it, and the bottle quickly corked, so that it will retain the gas formed by the effervescence produced, the result will be an artificial water exactly the same as the acidulated water coming from a spring. This author also teaches us to agitate the bottle in which the mixture is contained. This is undoubtedly the origin of soda water so largely used in England and in this country; but that the discovery should be attributed to Hoffmann cannot be based upon any foundation by the expressions given in his book by that author himself.

The real discovery of carbonic acid gas was made by Black (carbonic acid gas was discovered and made known really by Black) in the year 1756. He then gave it the name of fixed air. During the same year Black proved by experiment that the elastic fluid which develops itself during fermentation was the same as fixed air; then he demonstrated by the use of lime water that the combustion of coal also produces fixed air, and by his practical experiments he confirmed all the observations made by Van Helmont, Boyle and Hales. He came to the final conclusion that an alkali, or chalk, dissolved with an acid, will produce fixed air.

McBride, an English physician, was the first in applying carbonic acid gas in the treatment of putrid diseases, especially scorbutic, and in his experiments he used Black's apparatus, which he perfected by using a recipient with two openings in which to produce the gas.

In the year 1765 there existed not yet a real genuine process to manufacture or to imitate mineral waters, when one Schaw proposed to solve this problem, in a pamphlet specially written for that purpose. Then Dr. Brownrigg gave the first elementary basis in order to enable people to manufacture soda water, by stating in a memoir, read before the Royal Society of London June 13, 1765, the existence of fixed air in the Pyrmont mineral water. In the year 1767, Dr. Bewley, also an Englishman, prepared an imitation of the above named Pyrmont mineral water, by simply saturating pure spring water with the gas produced by the reaction of sulphuric acid on salts of tartar (carbonate of potash). For that purpose he used McBride apparatus. In the year 1768, Lane and Priestley produced an imitation of the Pyrmont water by concentrating the carbonic acid gas produced by the fermentation of beer to pure water. Dr. Lane, in order to produce a real ferruginous water, added a small piece of polished steel to the water. So we may assume that the experiments made by Bewley, Lane and Priestley were the foundation for the industrial production of carbonated and mineral water.

In 1772, Bergmann, a German chemist, published an interesting work concerning the production of carbonated waters, but he gives full credit to Priestley for the discovery of a practical apparatus, in his book. It is he, Priestley, who first demonstrated practically that it was possible to let the carbonic acid gas, after being produced by one or the other effervescing operations, pass into the pure water, and to combine this gas with it by agitating it in order to increase its saturation. In the same year Priestley published a description and a design of this apparatus, which we will describe hereafter. About the same time the celebrated savant Lavoisier, who for many years before had studied the same subject, published his opuscules of physics and chemistry, in which he proves that immense quantities of air did develop from metallic reductions, and gives a precise history of elastic emanations, fermentation and new researches on the existence of a fixed elastic fluid in some substances.

It had at that epoch been observed that the carbonic acid gas developed by the decomposition of chalk with an acid was not entirely pure, and that terreous and sulphurous emanations came along with it into the liquid to be carbonated, when a scientist by the name of Maquer suggested, in order to render the fixed air, as it was then called, more pure, and to clean it from these terreous and sulphurous emanations, let it run through another and a larger vessel filled with water, in which a certain amount of some calcarean earth had been previously diluted. This scientist says, in his "Dictionary of Chemistry," that by this means, should some of the reacting acid find its way into that vessel at the same time as the gas produced, it would be absorbed by the calcarean earth through which it was obliged to run before it could get into the recipient.

Bergmann completed and perfected this process by suggesting the washing of the gas simply by pure water. At about the same time an Englishman, Dr. Nooth, invented the first portable apparatus, the so-called family apparatus, now covered by an innumerable number of patents. The first one consisted of a combination of three glass vessels, superposed one above the other, and joined at their junction to avoid leakage. The lower vessel contains naturally the substances intended to help to produce the gas; the middle one holds the liquid to be saturated; and the third, the upper one, considerably smaller, is terminated with a long neck plunging down into the water contained in the second or the middle vessel. The neck of the saturating vessel was provided with a valve allowing the gas to pass through a sieve, and which naturally prevented the water from descending into the generating vessel. As soon as the gas produced in the generator arrives in the vessel containing the water, its pressure will drive the water from the second vessel through the pending neck into the third, or the superior one. When this last named vessel was full and the neck corked, the two superior vessels were taken off from the generator and well agitated, in order to promote the dissolution of the gas so produced. Replacing it again on the generator, a new charge of gas was admitted, and the same process of agitation repeated until the water in the upper vessels was fully and thoroughly saturated with gas. These apparatuses have since been assiduously perfected by many inventors. One especially, constructed in its time by Lavoisier, can now be seen at the museum of the Pharmaceutical College in Paris.

James Watt, the celebrated inventor of the steam engine, contributed also, in his time, a very important addition in the production and preserving of carbonic gas. To him is due the invention of the gasometer. The name of gasometer is nevertheless a more modern expression. This celebrated engineer called it the hydraulic bellows. At that time the gases, being produced by the so-called warm distillation, had to go through the necessary washing and refrigerating vessels and by these into a kind of bell suspended by a cord on a pulley supported by a wooden column in a cask filled with water, and provided on its other end with another weight for the purpose of keeping its equilibrium. As soon as the gas rushes in under the bell it is naturally lifted up, the water contained in the cask forming a hydraulic inclosure. From there it is connected by a pip into the reservoir, whose service it is to transfer it, or contains, itself, the substances with which it has to become mixed. In the year 1802, James Watt applied his hydraulic bellows to the hous-

ing and distributing of our present lighting gas, invented in the year 1792 by the French chemist Lebon. By this our readers can see that all the organs entering into the construction of our present apparatus for manufacturing carbonated waters and beverages were invented by most eminent scientists, and this only after long and careful researches and experiments. We may fix the first memorable date in the year 1740.

From the years 1740 to 1750 Hale and Black decomposed alkaline carbonate by heat, and mixed the gases resulting therefrom with water. In the year 1750 Vinel produced artificial mineral waters by the use of effervescing powders. In 1767 Bewley invented the generator by indicating positively that carbonic acid gas can be the operative in one vessel alone, and this by the action of sulphuric acid on an alkaline carbonate. In 1772 Priestley advised the use of sulphuric acid and chalk, and the dissolution of the gas by agitation. In 1773 Buequet introduced the use of faucets and that of the manometer. In the same year Rowell introduced and used vessels with two tubulures.

In 1774 Lavoisier advised the separated acid chamber from the generator, provided with a valve and a pipe in order to regulate the flow of the acid. Then he introduced the mechanical compression by the use of a pump, in order to draw the gas from the generator and bringing it into the saturating vessel. In 1777 the Duc de Chaulnes, a noble scientist, introduced the first agitator. In 1778 Marquer invented the first gas washer. In the same year Nooth invented the first portable apparatus.

In 1780 James Watt built the first gasometer, and since, how many interesting discoveries, covered by patents innumerable, have been added to the inventions of our illustrious forefathers.—Am. Carbonator.

THE FREE OXYGEN OF THE ATMOSPHERE.

By Dr. T. L. PHIPSON, Graduate of the Faculties of Science and Medicine of the Universitiy of Brussels; Fellow of the Chemical Societies of London, Paris, Antwerp, etc.

THE ancients looked upon the air as an element, and I have shown (Chemical News, 1893 and 1894; Comptes Rendus, id.) that in the earliest ages of the globe it was really so, for the atmosphere must then have consisted of nitrogen only, and the free oxygen which now forms part of the air we breathe is entirely the product of plant life extending over countless ages.

Since the days when Priestley showed that air made impure by a burning candle could be rendered pure again by the vegetation in it of a sprig of mint, until now, it has been admitted that green plants secrete oxygen gas; but before my publications alluded to above no one had ever shown that the vast bulk of free oxygen gas that forms part of the earth's atmosphere was entirely due to plant life, and that the plants of our present epoch are essentially anaerobic, as must have been those which vegetated in the primitive atmosphere of nitrogen, containing carbonic acid, and vapor.

It might be objected that the plants which first produced atmospheric oxygen must already have contained oxygen as part of their tissues. Whence did they derive that oxygen? But I have never said that plants were the creators of oxygen, only that they were the means by which Nature has placed free oxygen gas in the atmosphere of the earth.

Paleontologists generally admit that the lowest forms of plant life were the first to make their appearance, and on these would, of course, have devolved the function of preparing an atmosphere fit for the existence of animals. In experiments carried on during the past summer I have again confirmed what I have previously stated, namely, that these lower forms of plant life are precisely those which produce oxygen most rapidly and most abundantly.

These experiments are not so simple as might be supposed at first sight. My method consists in measuring (and reducing to 30 inches barometer and 0° C.) the oxygen given off in a certain time by various unicellular algæ and by phanerogamic plants high in the scale. These are then collected, dried at 100° C., and weighed. It was thus found that, weight for weight, the unicellular algæ gave by far the most oxygen. In one experiment, last August, a mixture, consisting chiefly of Protococcus and Chlamidomonas, was thus compared during five days with the common weed, Polygonum aviculare, and found to produce, weight for weight, fifty times more oxygen than the latter! In other cases different results were obtained, but in all the excess of oxygen was largely on the side of the unicellular algæ.

There are three important factors to be taken into account in making these observations: The intensity of the sunlight; the temperature of the day; and the amount of carbonic acid in the air and water in which the plants vegetate. In order to get comparable results these three factors must be the same in all cases; in other words, the experiment must be made with all the plants at the same time and in the same conditions. The most striking results were obtained with water saturated with carbonic acid, with bright sunshine, and with a temperature of 64° to 74° F.

Now between green plants, beings which are essentially anaerobic, and the more perfect animals, beings which are just as essentially aerobic, there exists a vast intermediate class which presents more or less the characteristics of both; such are the various organized ferments, fungi, and bacteria, etc., which represent the gradual transformation of the anaerobic cell into the aerobic cell under the influence of the gradual change of medium; that is, the constantly increasing amount of free oxygen in the atmosphere since the earlier geological ages.

In the common yeast fungus we have a familiar example of a cell which has undergone the influence of the change referred to—a cell which combines the plant and animal properties, and secretes carbonic acid in the conditions in which the green unicellular algæ secrete oxygen. In the latter case the oxygen evolved is separated from carbonic acid and the carbon retained by the plant; in the former carbonic acid is secreted by the yeast cell, just as in the higher animals, the function is far more complicated and requires a special nutriment, existence is rapid and short.

A small two ounce bottle, containing about 5 c. grms. of green unicellular algæ, filled with water containing carbonic acid and all the elements of a fertile soil, and exposed to sunlight every day, with only a temperature of 43° to 63° F. (and some very dark wet days, when the action was nil or nearly so), during the whole month of October, 1894, produced 14 c.c. of pure oxygen gas. So that a single pound weight of such unicellular algæ will produce at least 420 gallons of oxygen per annum, or 42,000 gallons in a century. The Casa Mia Laboratory, Putney, S. W.—Chem. News.

INK CRYSTALS.

EVERYONE is acquainted with snow or ice flowers, so called by Tyndall, and which are simply crystals of congealed water that form regular figures of great elegance. In order to see these crystals, it is necessary to make use of a microscope or a strong magnifying glass. Now, one has not always at hand a freezing apparatus that permits of obtaining these forms at will, and, besides, even when we have them before us, it takes but a ray of the sun or even the heat of the body to melt the flake of snow and cause the beautiful architecture to vanish.

Nothing of this kind is to be apprehended with ink flowers, since the material for the experiment may always be found upon one's desk at all seasons. These ink flowers are the work of nature, exactly like the ice crystals spoken of above, and all of whose effects they reproduce in a still greater variety of forms.

Take a pane of glass, and, having placed a drop of ink upon it and spread it out pretty regularly, allow it to dry for a few minutes, and then examine the result with a microscope that magnifies from 100 to 200 diameters. You will then see the ink flowers forming under your eyes, that is to say, regular figures that gradually appear in white upon the dark violet or blackish background of the ink.

If one is in haste to enjoy this spectacle, the glass may be passed back and forth over the flame of an alcohol lamp so as to expedite the concentration of the ink. The crystals in this case will be more numerous, but smaller in size. If one has the patience, however, to await the slow desiccation produced by the evaporation of the liquid, crystals of larger size and more varied

INK CRYSTALS.

form will be obtained: crosses, flowers, gems, etc., etc.

The experiment may be varied to infinity by hastening or retarding the formation of the crystals, and by interfering with or facilitating the aggregation of the crystalline atoms, either through alternations of temperature or through the addition of new ink to a plate that already carries formed crystals. It is probable that the composition of the inks of commerce has some influence upon the greater or less facility with which certain crystalline forms are obtained; but all inks having nutgalls and sulphate of iron as their basis will give analogous results.

When the ink is allowed to evaporate slowly, it is easy to recognize the crystalline system to which the ink flowers belong. We then obtain more or less perfect cubes, pyramids formed of superposed cubes, more or less perfect lozenges and needles and rods. Alongside of these forms, with well-defined angles, we find ovoid globules, and large spheroids with facets that recall the rough diamond. The flowers herewith figured are formed by the union of crystals of which each represents one of the sepals or petals of the flower. The Maltese cross or the flower with four petals is the normal or regular form, but we also frequently meet not only with the multiples of four, through the interposition of new crystals in the intervals, but also, through accidents of crystallization, flowers with three and five petals recalling the Rubiaceæ, the Liliaceæ, the Orchidaceæ, the Violaceæ, etc.

It has seemed to us that the greatest variety of forms is obtained by passing the glass very lightly over the flame of an alcohol lamp, but without placing it too near the latter. The evaporation is thus quickened and crystals of medium size are obtained that are very visible with a moderate magnification. It is well to heat the glass only at one of its extremities and to remove it from the flame before all the ink is dry. In this way we may obtain all varieties of crystallization, from the most rapid to the slowest.

What salt is it that thus crystallizes in the ink? We shall perhaps much astonish our readers when we say that we do not know, and that those chemists and mineralogists to whom we have appealed to help us out of our dilemma have not been able to give us much satisfaction. This is because it is not yet known exactly what reactions take place in ink, as Mr. Wurtz himself confesses in his "Dictionary of Chemistry."

Doubtless, we well know the ingredients of ink; any manufacturer can inform us as to this. Ink is an aqueous solution of nutgalls and copperas to which is added gum arabic and some antiseptic or other to prevent the formation of mould. We know, then, what goes into ink, but we do not know what comes out of it, and such ignorance is common concerning this compound and many others of organic nature, whose composition, and, consequently, chemical reactions, are quite complex.

What we do know is that the salt crystallizes according to the cubical system, since its crystals do not polarize light. We find, besides, that they are deliquescent and alterable in the air. In fact, if we preserve one of these preparations for examination on the morrow, we find that the crystals have lost their luster and their regularity, and we have before our eyes merely a very attenuated reflection of the spectacle that we admired the day previous. This effect of deliquescence, however, is not observed to an equal degree with all inks.

It is probable that the salt with which we have to do here is magnetic oxide of iron (Fe^3O^4), or perhaps white pyrites—the bisulphide of iron, called also marcassite. We should incline toward this latter substance on account of the white color of the crystals and the facility with which they group themselves in crested or peritomous macles. It is these macles that constitute the elegant crosses and flowers mentioned in the beginning. We do not think it can be a question of an organic salt, such as gallate of iron, for the latter crystallizes in needles and not in cubes.

We may add that we have not been able to find the magnetic property that characterizes the ferrosoferric oxide, while the alteration of the crystals by the humidity of the air is one of the characters of the white pyrites.

On another hand, the predominance of the cubical system seems to indicate the ferrosoferric oxide rather than the white sulphureted iron, which ordinarily crystallizes in the orthorhombic system. We submit this difficulty to chemists and mineralogists, who will doubtless be able to solve it by studying the phenomenon closer by. We here confess our incompetence, and ask the question: What is the salt or salts of iron of which these crystals are formed?—La Nature.

THE PREPARATION OF COCAINE.

THE complete separation of cocaine from the accompanying alkaloids found in the leaves is a troublesome and tedious operation, and has been superseded to a large extent by methods based on our knowledge of the constitution of these alkaloids.

It has been shown that the chief alkaloids found in the leaves are cocaine (methylbenzoylecgonine), isatropyl-cocaine, and cinnamyl-cocaine, and they may thus be considered as built up from methylecgonine by combination with different acid radicals.

The principle of the process employed* consists in the decomposition of the accompanying alkaloids by acids, the formation of ecgonine by splitting off the different acid radicals as methyl esters, and the subsequent partial synthesis of cocaine from the ecgonine thus obtained.

The method employed is as follows: The leaves are extracted by a suitable solvent, and the greater part of the cocaine is removed by fractional crystallization. The alkaloidal residue, containing a little cocaine, is then decomposed by boiling with strong hydrochloric acid into ecgonine and the methyl esters of the different organic acids. Finally, the ecgonine is separated and purified, and then converted into cocaine. Two methods can be employed for this conversion: (1) The ecgonine is first benzoylated and then methylated by treatment with methyl iodide and soda, or, better, by passing dry hydrochloric acid gas into a solution of benzoylecgonine in methyl alcohol (Einhorn); or (2) the methyl ester of ecgonine is first formed, and then benzoylated to form cocaine. In both cases we require to add the two groups, and for this two operations are necessary.

Einhorn has devised a method (Bericht, xxvii., 1523) which necessitates only one of these synthetical operations, and this depends on the fact above stated, that the different alkaloids may be viewed as consisting of methyl-ecgonine combined with different acid radicals, and instead of decomposing the total alkaloid into ecgonine, the methyl ester of ecgonine is obtained, which then only requires benzoylating to yield the required alkaloid. The method is as follows: 50 grammes of the accompanying alkaloids are boiled with 300 grammes of methyl alcohol and 100 grammes of pure sulphuric acid for 3 to 4 hours in a water bath. The alcohol is then distilled off and the sirupy residue treated with a little water in which the methylecgonine is dissolved, and the greater part of the organic acids precipitated as methyl esters. The aqueous solution is now extracted with chloroform, and then made alkaline with excess of potassium carbonate, when the ecgonine methyl ester separates as an oil, which is then easily extracted by chloroform. A modification of this method consists in passing dry hydrochloric acid gas into a methyl alcohol solution of the accompanying alkaloids, and, after cooling, heating for two hours. The methylecgonine is separated by the same method as used when sulphuric acid is employed.

The yield is found to be theoretical, and the resulting methylecgonine was recognized as such by purification and the identity of the melting point of its hydrochloride with that previously recorded. It can be distilled with very little decomposition in a vacuum.

When the methyl alcohol is replaced by ethyl alcohol, the higher homologue of cocaine is obtained, and we have thus a simple method at command for forming any of the higher homologues by dissolving cocaine in the required alcohol, and saturating with dry hydrochloric acid gas and boiling for two hours.

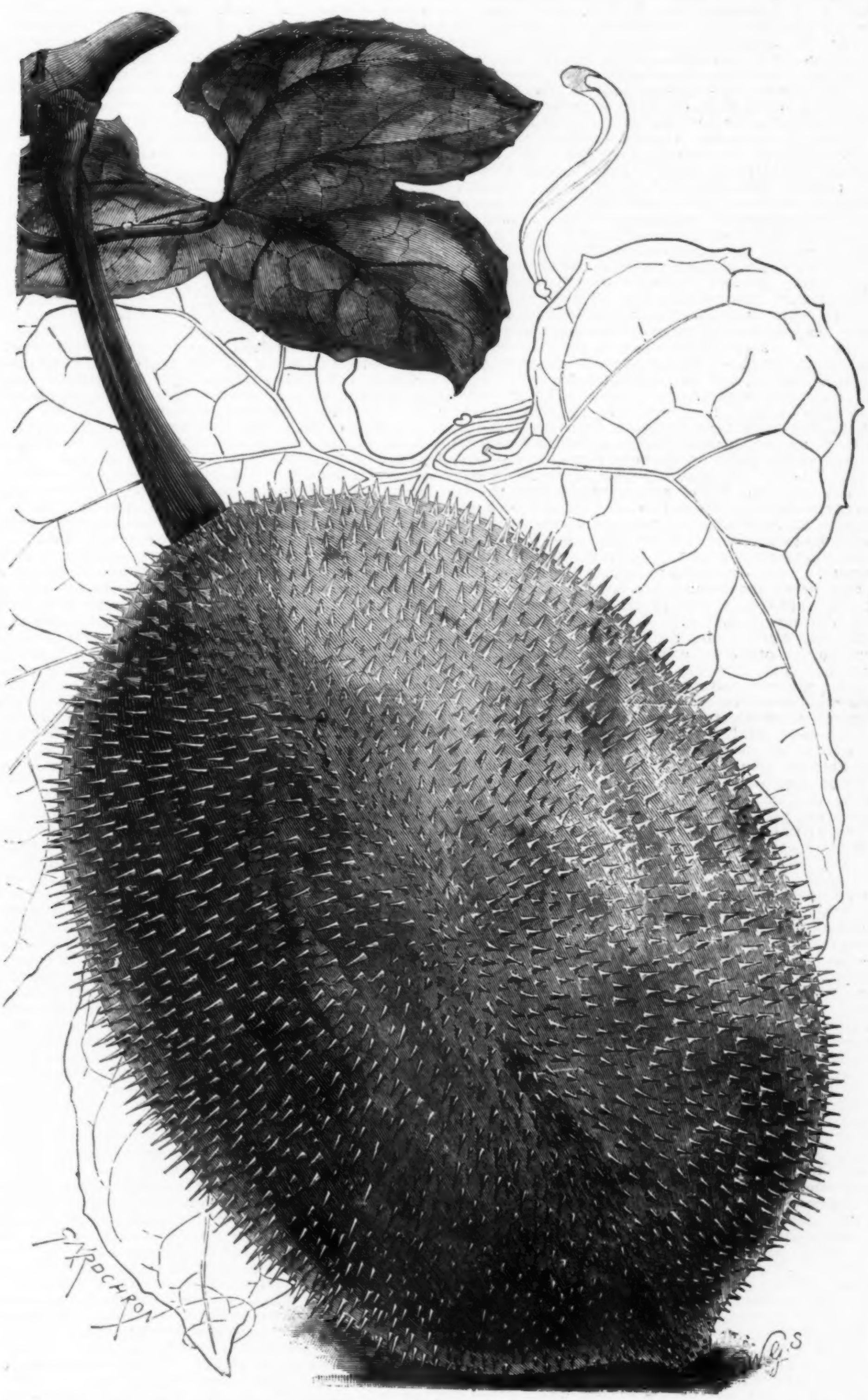
The process above described depends on a very general method of preparation in organic chemistry, viz., the formation of a methyl ester by treatment with methyl alcohol in presence of sulphuric or hydrochloric acid. In this case the ecgonine is produced under conditions that at once induce the formation of methyl-ecgonine, which then only requires benzoylating to yield cocaine.—Pharmaceutical Journal.

* Liebermann and Giesel. Bericht, xxi., 3196. Einhorn and Klein. Bericht, xxi., 3335.

MOMORDICA MIXTA.

THE magnificent gourd shown from Kew under this name at the last meeting of the Royal Horticultural Society attracted much attention from its brilliant coral red or crimson color. Our illustration shows the fruit of its natural size, studded with short conical spines. It is a native of India, Cochin China, etc., and was figured in the Botanical Magazine, t 5145, and in the Flore des Serres, 14, 1478. According to the Kew Index, M. cochin-chinensis is synonymous, but under whatever name it may be known, it must be admitted to be one of the most splendid tropical climbing plants.

The flowers are described as four inches across, with five ovate lanceolate sepals with black stripes, and a bell-shaped, pale yellow corolla, with a purple eye.



FRUIT OF MOMORDICA COCHIN-CHINENSIS SYN. MIXTA—FRUIT REDDISH-CRIMSON.

The leaves are cordate, palmately lobed, and their stalks are provided with cup-shaped glands. Judging from the acrid properties of its nearest allies, we should hesitate to consider this plant in any other light than as an ornamental one.—The Gardeners' Chronicle.

EIGHT TONS OF SUGAR TO THE ACRE.

A DEMERARA sugar planter received from a friend engaged in the sugar industry of the Sandwich Islands some statistics from the factory in which he works, disclosing a richness in the cane so far in advance of the very best returns ever obtained here that he felt disposed to question the correctness of them. His friend has replied, assuring him that there is no mistake; and his letter having been placed at our disposal, we take the opportunity to let our readers in general know the extent of the returns obtained from cane grown in the Hawaiian volcanic lands. To quote:

I am not at all surprised at your skepticism with reference to our return of sugar per acre of cane, but were you to see the cane we grow here you could then understand that our return must be high. Last year from a piece of land of 160 acres we got 8·9 tons of sugar per acre. I will talk to our chemist and see if I can get from him all the figures in reference to this, so that you can better understand how it is. Our acreage for last year's crop was 2,207, and our output of sugar (three grades) was 13,008 tons. I am sorry that our company published no report of the working of that mill for last year, otherwise I would have sent you a copy of it, but I understand they are going to do so this season, and as soon as it is published I will send you a copy. About the lowest return from cane here that I know of is five tons per acre. If you only saw the cane here before it is cut, you would understand our high return. I am sending the firm of Messrs. Mirrlees, Watson & Yaryan Co. the working of our mill from January 2 to 27, so will just give you here a few of the figures I have got from the chemist. Mill work from January 2 to 27, twenty-two days' driving, counting Saturday as a full day (although it is really only half day), 1,748 tons of sugar manufactured; 79½ tons per day, 1 ton of sugar to 8 tons of cane. The working of the mills on the islands here is not on the same principle at all that is in vogue in India. We begin in December and go straight on cutting until the finish of the crop, which is generally in July or August. I will talk to the chemist and see if I can get him to make me up a few figures of the working of last year's crop, which will probably be of interest to you. If I am successful, I will inclose them with this.

The returns referred to were inclosed in the letter, and as we think they are worthy of consideration, we publish them also. They are signed by the chemist of the estate, but we do not consider ourselves at liberty to give either his name or that of the estate.

April 3, 4 and 5, 1893, and April 28, 94 acres of cane taken off. Sugar manufactured: 1st, 1,432,875 pounds; 2d, 303,875 pounds; 3d, 88,570 pounds; total, 1,825,320 pounds = 912·66 tons = 9·71 tons per acre. Cane juice, brix, sucrose, 17·17; purity, 870; tons of cane, 19 74; 7,008·6; 7·67 tons of cane to 1 ton of sugar.

January 15–27, 1894. Tons of cane, 6,785; juice brix, 21·94; sucrose, 19·08; quot., 87·0. Sugar manufactured: 1st, 1,299,750 pounds; polarization, 96·5 deg.; 2d, 396,375 pounds; polarization, 90 deg.; 3d, 141,250 pounds; polarization, 89·6 deg.; total, 1,837,375 pounds; 7·38 tons of cane to 1 ton of sugar.

January 29–February 10, 1894. Tons of cane, 7,265; cane juice brix, 21 18; sucrose, 18·61; quot., 87·9. Sugar manufactured: 1st, 1,454,625 pounds; 2d, 443,625 pounds; 3d, 125,000 pounds; total, 2,023,250 pounds. Sugar per ton of cane, 278 pounds; 7·18 tons of cane to 1 ton of sugar.

When Demerara planters can report a return of seven or eight tons of sugar to an acre of canes, the bounty question and other present bugbears will have no terror for them.—Argosy.

[FROM THE NINETEENTH CENTURY.]

BABIES AND MONKEYS.

By S. S. BUCKMAN.

IT is still a matter of scientific discussion whether man is descended from Catarhine or Platyrhine monkeys, or from the Lemuroidea; but there is little question that his ancestors were monkey-like, that they were decidedly prognathous, that they were covered with hair, that they had long tails, that they were arboreal, and that they used both the pedes and manus as hands—the former more than the latter. Man's ancestors, therefore, were very much like monkeys—they were Simial or Simioid, "monkey-like;" and could he see them at the present day, an unzoological critic would probably call them "monkeys" without much cavil.

The Latin word simus (Greek σιμός), whence our term "Simia, monkey," means literally, "flat or snub-nosed." This very feature, so striking in monkeys as to have become a name for all of them, is very remarkable in our babies. Viewed in profile, a baby's nose will appear to make a concave curve, the nostrils being obliquely truncate. The length of the nose is only equal to the breadth across the nostrils, and those are remarkably large, parted by a broad septum. During life nothing changes more than the nose. As the baby grows into a child the length of the nose increases faster than the breadth, so the snub-nosed baby grows into a more or less long-nosed, and, it may be, hook nosed adult. The snub nose remains a marked feature for a longer or shorter period of life; this is a matter of sex and parentage or race; but the change is gradual and imperceptible, generally more expeditious in the male than in the female, correlated with various other characters, such as intellectual attainments or weak constitution, and producing somewhat different results. The change, however, in the shape of the nose is one that continues throughout life. During maturity and senescence the bridge of the nose tends, as it did during childhood, to become more and more prominent; often it will become more and more convex, so that extreme old age may frequently develop an aquiline nose, even in some cases to produce the nut cracker type of nose meeting chin so noticeable in old people.

It is only by a study of the face in profile, and of the face of the same individual at different ages of life, that the above changes can be properly noticed. The three-quarter photographs which we leave behind at the present day, faked up by the photographer's art, will be useless to the men of the future as records to tell what manner of people we were. With lapse of time, the widening of the family circle, and the various incidents of a workaday life, it is doubtful if these pictures will be regarded with any reverence or affection by our posterity from a merely sentimental point of view. But this would be changed if photographs were, as should be all photographs which aim to give a true picture of the face, taken just two ways, profile and full face. They would then be of scientific value; and even a dilettante scientific amateur of the future would esteem a family collection as something of interest for the lessons in evolution or anthropology it might teach: perchance, the theme might be the "Inheritance of Acquired Characters." The want of such photographs at the present day makes it extremely difficult to impress upon the layman or to prove to the scientist how much people change facially during life. Three quarter views give but a feeble idea of the development. Nothing is more remarkable than a comparison of the same sized profile views of the same person at six and at thirty years of age: the growth of the nose and the development of the forehead are so great that the jaws appear to have diminished in size, and this is really what the jaws have done, in proportion to the whole face.

It is a fond delusion with visitors and nurses that the baby is like its father or mother. No one who has had that scientific training necessary to proper observation could make such a statement. It is a gross libel, sometimes on the baby, sometimes on the parents. Properly taken photographs show that the proportions of nearly every feature in the face of a baby and an adult are entirely different; but the greatest difference exists in the size and shape of the nose and the size of the jaws. If, when adult, we had features like our babies, we should have a countenance of a negroid type. Except positive evidence be available, it would hardly be credible that the small jawed, long and prominent nosed individual, with high forehead, was in babyhood prognathous, short and snub-nosed, with a remarkably receding forehead. The difference resulting from the change during life as shown by two photographs reduced to the same size, not the same proportion, is greater than the difference between many species; yet the very fact of such metabolism and the possibility of its earlier transmission from generation to generation may be the basis of specific mutation, without calling in the aid of natural, or sexual, or physiological selection to account for that phenomenon.

The prognathism of a child is less noticeable than it should be, because such prognathism, owing to the disposition of weight, alters the whole carriage of the head, and the difference in the method of carrying the

head obscures the prognathism to a certain extent. Prognathism is a heritage from quadrupedal ancestors, and is a necessary result of the carriage of the head enforced by a four-footed mode of progression. The attainment of the upright body position of man tends during the course of his life to reduce prognathism—an adult is far less prognathous than when a baby; and it has tended during phyletic development to the same end—the European, the more developed form, is less prognathous than the negro. Reduction of prognathism leads to a better carriage of the head, because the weight is borne nearer the perpendicular, which is economy. Economy, it may be remarked, is most important to the man whose expenditure and income are too nearly on a par; and this dictum of necessity applies to civilized man, whose income in the shape of physical and nervous energy is much less, and his expenditure far greater, than that of the savage. But there are other factors at work: the civilized man requires the enlargement of the frontal capacity of his skull, and material saved in jaw making can be utilized in skull enlargement. Then there is the lessened use of teeth and jaws in mastication, and therefore a smaller demand upon those organs; these and other causes all work to the same end—a reduction of prognathism. If any one will draw to the same size the facial profile of a cat, a monkey, a baby, and an adult man, he will have represented four stages in the reduction of prognathism, and he will begin to understand to what the prognathous baby points. He will learn that in a designed biped the heavy jaw is a piece of faulty construction reflecting no credit on an artificer, whereas it is a necessary accompaniment of a biped developed from a quadrumanous or quadrupedal animal, imperfectly, incompletely, and gradually adapting himself to the bipedal position.

Attention may be called to another feature pointing out the same lesson of alteration and imperfect adaptation. Below the nose runs a furrow parting the upper lip. In the faces of babies and children this furrow is very noticeable: from the evolutionist's point of view it is one of the most remarkable characters of the face. It tends to become obsolete in old age, and it is not seen among the Catarhine monkeys. Among the Platyrhines it is but feebly developed; but in Lemurs it is in a more pronounced state—there is a depressed septum to which the two side pieces are joined—the upper lip, in fact, is nearly split in two, but held together by a depressed piece of flesh. In the Marsupialia and Rodentia the lip is practically in two pieces, and each piece is capable of being moved separately. This is the "harelip;" and its method of use may well be noticed in a hare or a rabbit when eating. The furrow, therefore, in a child's lip points to this: that our ancestors possessed, not a single upper lip, as we do now, but two upper lips, one beneath each nostril, both capable of independent movement. In course of time these two lips have, owing to the non requirement of independent movement, grown together to form the single lip which we now possess; but the line of junction is not perfect, and so the furrow results; and sometimes there is a distinct scar down the middle of the furrow. The possession of this furrowed upper lip by children is one of the strongest pieces of evidence against the descent of man from any Catarhine, and in favor of his descent from Platyrhines, or from Lemurs through the intervention of Platyrhine-like ancestors, of which there are no exact living representatives.

Another feature of a child's face is capable of similar explanation as a vestigeal relic of its ancestors' other modes of life. The pouch-like cheeks of babies are particularly noticeable, and may be especially remarked in the representation of cherubs adorning ecclesiastical monuments. In such connection it savors of sacrilege to suggest that these inflated baby cheeks, so much admired by all mothers, and regarded by churchmen as particular features of a hypothetical higher sort of beings—angels—are really the attributes of a lower order, and are the vestiges of cheek pouches, possessed for storing away food, as in Cercopithecus, a monkey in which this habit of storing may be observed at the Zoological Gardens, if visitors feed it.

There is no need to enter into embryological or anatomical details concerning the characters for which children are indebted to monkeys. They possess in common with their adults a rudimentary tail hidden beneath the skin; but this is not a fact that every one can verify on the instant. Yet those who have the care of children can easily see for themselves the scar which the loss of the tail has still left on children's bodies—a scar which is curiously similar to what would obtain after amputation of a tail. Just at the base of the vertebral column—exactly where the tail would protrude through the flesh if it were functionally active—is a deep circular depression, sufficient almost for the insertion of the little finger. In young babies it is very noticeable; and nurses, while wondering what purpose it serves, abuse it as a place which is difficult to wash. In older children it gradually becomes shallower; and in those about five or seven years old it may or may not be shown. That it marks the place where a tail formerly protruded in our ancestors there can be no doubt from its shape and its position. I was curious to see if the anthropoid apes, which share with man this loss or rather atrophy of the tail, also exhibited this tail mark; and I was interested to notice, in an adult female gorilla in the British Museum, that the tail mark was as large as a florin. Its persistence to the adult stage in the case of the gorilla and its earlier loss in man is probably accounted for by the latter having attained a more perfect upright carriage of the body, and, therefore, a consequent increase of necessary muscles have occupied the somewhat vacant space.

Other characters, however, tell the same tale of adaptation. The proportion in length between the arms and legs of a baby when first born is very different to what obtains later in life. To use a somewhat incorrect phrase, the legs are in an undeveloped condition, and they have to grow quicker, in proportion, than the arms. The greater development of the arms in proportion to the legs in a new-born infant points to ancestors who used the arms more than the legs for sustaining the weight of their bodies, and this would mean that they lived an arboreal life. Dr. Louis Robinson, in an interesting article,* has fully illustrated the reason for superior arm-power in infants by his experiments on the hanging power of babies.

* Nineteenth Century, Nov., 1891, p. 838.

In the method of using its hands the baby shows to the full its descent from arboreal ancestors. When it wishes to take hold of anything, alike a glass or a flower-pot, it does not, like an adult, put the hand round it, or even put the thumb inside to use as a lever. On the contrary, it places all the fingers inside, makes no use of the thumb, and clasps the rim of the flower-pot between the fingers and the palm of the hand. This is exactly the action which would be acquired from arboreal ancestors: in going from bough to bough they would take their hands palms first, and would strike from above downward, grasping the bough with the fingers. Such is the action of an infant picking up a cup. So little use have some monkeys made of the thumb that abortion has resulted; and in the most arboreal species of monkeys known the fingers have grown together because the whole hand was used merely as a grasping-hook. It is probably from our ancestors' excessive use of the hands in bough-grasping that our babies inherit a certain inability to move the fingers with freedom, or to extend the hand, especially if the least degree cold. The power to extend the fingers perfectly straight is oftentimes not obtained by children at six or seven years of age.

Turning to the characteristics of an infant's feet and its habits of movement therewith, much instruction may be obtained by noticing these matters. Darwin observed the infant's ability to twist the sole sideways in a straight line with the inner part of the leg, a necessary ability to a tree-climbing animal; and he cited it as evidence of monkey-ancestry. Considering how little an adult can move his or her toes the power of movement of these organs by an infant is something remarkable; and it points to some ancestral environment of very different character from that which surrounds Man at the present day. The big toe the infant can project at an angle from the next toe, and the space between the big toe and the next is really the remnant of a space similar to that seen between our thumb and forefinger, when the toe was used for grasping like a thumb, and was opposable.

It is not, as churchmen would have us believe, a relic of sandal-wearing times, and a special provision of a Deity for the patriarchs to strap on their sandals; it is a relic of monkey-ancestry taken advantage of by the ancients as the most appropriate place for the sandal strap. The big toe further reveals its former thumb-like use in the fact that it and the thumb are the only two of the digits in which the last joint can be bent at will and independently of moving others. This can readily be exemplified in the thumb: the baby is fond of showing its power in this direction with its big toe. Further, a baby can move any of its toes independently, and it can move them one from another so as to make a V between any of them. As it grows older it loses this power and also the power of turning its ankle; but that it has such power over its muscles when young points to ancestors who used their feet more than their hands as organs for picking up small objects; and who relied on their arms and hands for supporting their bodies. Now we have reversed this process; we require our feet merely for pedestals, and as such they would be quite as serviceable to us did we possess but one toe. In time we may obtain to that monodactylous condition, for abortion of the toes is proceeding very rapidly. In a great measure we owe this to boots; and the more we try to hasten, unconsciously perhaps, this process of toe-abortion, the more we shall suffer. We suffer enough as it is in this respect. Certainly the sandal-wearing ancients were not free from encouraging the toe-abortion; for the examination of any old statuary will reveal a very marked abortion of the little toe, as a consequence of the strap pressure; and there is even a certain amount of elevation of the outside of the foot from the ground, partial atrophy. Though from a hygienic point of view sandals were preferable to boots, nothing at all, except in extreme climatic conditions, would have been preferable to sandals. Boots are a curse to civilization.

Every now and then one receives missionary circulars asking for sympathy and pity on behalf of children running about without shoes and stockings, citing it as a terrible proof of poverty. After all it is the best thing for them; many doctors are prescribing "barefootedness" in cases of limb-weakness; and it is a good thing for all young children. There has been too much fussy meddlesomeness in these respects, particularly among savage races. Thus, Mr. J. Theodore Bent says: "The missionaries who teach and insist on clothing among races accustomed to nudity by heredity are responsible for three evils: first, the appearance of lung diseases among them; secondly, the spread of vermin among them; and thirdly, the disappearance from among them of inherent and natural modesty." It is a terrible indictment of the clothes-culture. When shall we be educated enough to know that clothing and decency are not synonymous terms, and that a fig-leaf is a greater outrage on good taste than is absolute nudity?

It is remarkable how much unnecessary suffering is inflicted on infants and children because parents fail to recognize the ancestry from "animals,"* and consequently the instincts, different from those of adults, which children have inherited. Thus Dr. Louis Robinson has pointed out that as soon as children are able to shift for themselves in bed, they go to sleep on their stomachs with their limbs curled up under them; and he has rightly traced this to quadrupedal ancestors. Experience shows that if mothers would only recognize this ancestry, and would put their children to bed less enveloped in clothes and less tightly tucked up, so that these children might easily shift into the position which inherited instinct tells them to assume, they (the mothers) would have far more comfortable nights and better-tempered, healthier children.

Even the very manner in which babies are got off to sleep—by rocking in the arms or in a cradle—is an inheritance of arboreal or monkey-like ancestors, because the rocking is an imitation of the to-and-fro swaying of the branches, and such swaying would be the natural accompaniment of sleep with arboreal dwellers. Any rhythmic motion seems to leave a very marked impression on organisms: thus, sailors after a long voyage complain of their inability to sleep upon land; because the sleep has been too long associated with the rocking of the vessel. More remarkable still, however, is the result of some experiments made by Mr. Francis Darwin and Miss D. Pertz* on "the Curvature of Plants." They used an intermittent klinostat, arranged so as to reverse the influence of gravity on a growing shoot or stalk every half-hour. When the clock was stopped they found that the rhythmic movement still continued, that the shoot or stalk actually curved in opposition to gravity for the half-hourly interval before finally obeying the impulse to grow downward. In the case of heliotrophic curvature the effect was even more marked. "After the clock was stopped, the seedlings away from the light for two half-hourly intervals separated by one of curvature toward the light, so strongly were they imbued with the artificially induced rhythm." What is remarkable in these cases is the effect produced after a very short space of time. It would, therefore, be reasonable to conclude that the effect of thousands of years' association—as in the case of rocking with sleep in arboreal dwellers—would still be found to influence children very long after arboreal life had been abandoned.

* "Christians" and "animals" is the popular classification. See too Ibsen, An Enemy of the People, interruption in Dr. Stockmann's speech, "We are not animals, doctor" (Act. iv.)

It is certainly singular to find that nursery ditties contain reference to matters arboreal, as if there were some lingering tradition in the human race of ancestors who lived in trees. Thus the English mother or nurse in rocking her infact to sleep sings:

Lullaby baby on the tree top;
When the wind blows, the cradle shall rock;
When the bough breaks, the cradle will fall
And down will come baby, cradle, and all.

Somewhat similar is a German nursery ditty:

Schlafe, schlaf ein, mein Kind.
Horch! da draussen der Wind;
Wie das Voglein im grunen Baum,
Wiegt er auch dich in sussem Traum.

Nowhere is a stage of a former arboreal life, with its consequent climbing instinct, manifested more conspicuously than in the insane desire of an infant to climb up stairs. As soon as crawling is an accomplishment the climbing of stairs is attempted. Remain on the level and crawl about rooms the child will not; it must make for the nearest stairs to climb with loud crows of delight. Tumbles and consequent bruises have no effect on the child's climbing instinct, and really it regards them far less than the prohibition of its climbing feats by a too fond and foolish mother. It is better to let the child climb: even a fall down the whole flight of stairs only checks the climbing mania temporarily, in order that the infant may loudly express its disapprobation of its own clumsiness, and may vent its anger in howls. But this episode over, it will, within a quarter of an hour, bravely attack the stairs again, having quite forgotten its late disaster. An instinct held so tenaciously cannot be regarded as something fortuitous. Darwin considered that the tree-climbing propensity of boys was a relic of monkey ancestors, but he made no observation on the stair-climbing instinct of infants. Mothers, unfortunately, do not always possess enough scientific calmness to watch an infant climb stairs with every chance of a tumble, so they are apt to cut short such experiments. But if left alone—and that is the best plan—it is remarkable how soon the child learns not to tumble; and then the mother need have no more fear.

The early efforts of a child in leaning to walk indicate the habits of an animal to whom the upright position is something strange. The baby is decidedly bowlegged, but this shape of leg would be exactly that necessary for tree-climbing quadrumana. When it is first stood up, the baby puts only the outer parts of its feet to the ground, and turns its toes in. It does not allow its heels to touch the ground: when a monkey walks on a branch it does not allow the homologous part to our heel to touch the branch. When a dog sits, as we call it, to beg, it really brings the same part into contact with the ground as we do in standing: it brings its hocks (heels) flat to the ground, and supports its weight on the hocks and toes. Children are very fond of "sitting on their heels" in the same manner as a dog when it begs. The difference between the begging attitude of a dog and the standing of a child is in the straightening of the knee joints in the latter. As a dog has not the power to straighten the knee joint, because of its quadrupedal habits, it cannot stand on its hocks as we can; as soon as it raises its body on its hind legs it elevates the hock from the ground. The power to straighten the knee joint, and so to put the hock to the ground, is not inherent in babies at first: it is only by practice in walking that they are able to acquire it. Why, if babies' ancestors have always been animals walking on their hocks, should these processes have to be gone through?

The movements and habits of a young baby seem so strange to us because they are so different from those made by adults, and because they are so unconsciously performed. Joy is expressed by muscular movements, by wriggling of the hands and toes, or by convulsive beatings of the arms when it is small; by "jigging" when it is larger. These movements are expressive of joy, because to any animal of highly developed muscular energy movement is absolutely essential and particularly pleasing, while stillness is the reverse. It is muscular excitement, chiefly, no doubt, electrical, a heritage from ancestors who knew not what it was to be still, that gives that restlessness to children and causes them to find so much pleasure in mere motion and muscular exertion of any kind. Jumping for joy is very literally correct of a child's expression of pleasure. The prospect of a sweet will excite a series of leaps to indicate delight; and they further serve the purpose of relieving the tedium of waiting the half second necessary to the donation. The pleasure of finding a bird's nest with eggs in it—a pleasure which must have been very real sometimes in the case of hungry monkeys and savage man, but is now only a survival of the instinct thus formed—this pleasure a boy expressed by a series of convulsive leaps into the air, and during the performance not only were the arms and legs moved as much as possible, but the muscles of the stomach and vocal organs had to be utilized to cause accompanying shouts. It may be remarked that in adults, when limb move-

* Journal of Botany, cit. Natural Science, vol. ii., p. 9.

ments are less active, shouts are, on account of the muscular action involved, a necessary accompaniment of joy, noticeably 'Arry on a bank holiday; while in some cases expletives are symptomatic of joy and not of anger. All these outward signs have had their origin in that nerve excitation inducing muscular action which is a heritage from ancestors who, impelled by hunger, by love, or by war, led more active lives and thereby obtained a desire for motion as a second nature. Children and young lambs are very familiar examples; and so strongly will the latter pursue their gambols and racings that a broken heart is sometimes a cause of death in the middle of a sudden gallop. If children have to be still it is torture to them—positive torture in some cases—and grown-up people are unaware how much, or they would not thoughtfully inflict it on young children. Muscular ache, the fidgets, growing pain in the limbs, are all the result of enforced inactivity in children. It is similar with athletes: their muscular excitement is so strong that movement is pleasure, stillness means pain, and they are noted for restlessness.

Another "animal" relic which exists in children is an instinctive desire for stealing, especially for stealing fruit, which, however hard and unripe, seems to give the child pleasure. Stealing certainly points to the time when every animal had to depend on its own exertions for what food it got, and when the readiest method of obtaining such food was to appropriate without question whatever it might come across. The capacity for hard and unripe fruit indicates a necessity which would be incidental to monkey-like life—to times of scarcity, when anything in the shape of fruit, no matter what it might be, was gladly welcomed as food.

With the above another childish trait may advantageously be compared, namely, the habit of taking things to bed, especially such articles as the child may be attached to; but there is also a desire to take things for fear of other children obtaining them; and when a child takes off to bed such articles as a collection of clothes' brushes or an array of old boots, it seems like taking for taking's sake. Thus one boy was found in bed with sundry drawer handles, unscrewed for the occasion, several pieces of old iron, two hair brushes and a tobacco tin. Many causes have contributed to form this habit. First, there is the earlier inheritance of the maternal instinct; the mother taking her young to sleep with her in order to feed and comfort it would give the idea of taking to bed anything exciting fondness—dolls, toys, etc. Then there is the food instinct—the dragging-food-into-the-lair idea—with which may be associated a particular fondness of children for something to eat when they are in bed; and then there is the proprietary idea, arising from the feeling that to keep possession of articles it is necessary to sleep with them, if not on them. When a young child is trying to resist another from taking things away from it, the usual method it pursues is to put the articles between its legs, to push away its assailant with its hands and to scream loudly. During the scream it brings its mouth into a particular shape to show its canine teeth to the best advantage, and it frequently puts its head forward, especially protruding the chin so that the other animal may have a good view of its canine teeth. This is what the reason was; with a child, of course, it is a case of inherited habit and association, because it has never known how to fight with the canine teeth.

The earlier inheritance of the maternal instinct is worth noticing further; the doll proclivity of girls is a particular instance of earlier inheritance thereof. Doll-nursing instinct is not shared in the least by any healthy boys, nor can they take to little household duties with the handiness of a girl. Boys' earlier inheritance is all in the way of offensive weapons, of bows, bats, balls and noise, with a tendency to teasing and bullying, a feature for which the male has been famous, the sufferer who was put upon being the female—the weaker vessel; weaker because the males fought with one another for her; had she fought with her sisters for the males, she could have been the stronger and the bigger brained.

The female, however, does inherit a pugnacious instinct, chiefly defensive. She has had to fight on behalf of her young ones, and in such cases the maternal instinct becomes very strong indeed. Children show this character; and I witnessed in one of mine a very curious exhibition of what might be called perverted instinct, arising from a conflict of inherited associations. She was quite a little girl and was nursing her doll with all possible expression of affection, loving it, kissing it and calling it all the endearing names she knew. Up came her brother, and began to tease her. In an instant the pugnacious idea was aroused in defense of the doll, but, having no available weapon in hand, she seized the doll by the hind legs, and, wheeling it aloft, brought its china head down with resounding force on the cranium of her brother. He retired, howling and discomforted. She, excited with her triumph, returned to the caressing of her doll with redoubled ardor, quite unconscious of the incongruity of her actions, an unconsciousness which heightened the comicality of the incident.

Another habit of children—a sadly destructive habit too—is that of picking at anything loose, any piece of wall paper especially, so as to tear it off. This habit is a survival of a monkey practice of picking off the bark from trees in order to search for insects. Any loose piece of bark, even the very least displacement, indicates an insect refuge, and immediately suggests live prey; so that with the monkey there is a definite association between loose bark and food. With the child the reason for picking at loose things has been lost, but the instinct to pick remains as a vestigeal survival, traceable to a definite food-acquiring instinct of the monkey. There may also have been an association with the monkey habit of picking out one another's parasites, a habit which is very noticeable among them.

To those people, and they are many, who scornfully repudiate their monkey ancestry, it may seem farfetched to notice such a childish habit, and to assert that it had any such origin; but many instances may be cited of habits acquired for some beneficial purpose or in connection with some particular circumstances of life, persisting both in the life of the individual and also being perpetuated in the race long after the reason for the habit has been forgotten—not unlike superstitious ceremonies and religious observances which survive in a similar way. Thus there is the fear of women for snakes and the consequent loathing and hatred—feelings which seem so unreasonable to many of the strong minded people of the present day. We have written evidence that these feelings were subject of comment at a very early age of man's intelligence; and it may readily be surmised that the story of Genesis is only the written account of what had been verbally told for many generations. Mythical as it is, it seems a most ingenious method of accounting for certain observed facts, and that the facts were observed reflects considerable credit on the observers. As mythology it takes high rank; its very naivete adds to its charm. "Whence arise these feelings in respect of snakes?" was the inquiry; and in answer thereto the legend gradually grew up, that "the snake was the tempter; of the presumed mother of all, Eve; he is just such as would be a tempter; his very habits, stealthy, gliding, silent, self-concealing, show at once that he 'is more subtile than any beast of the field.' Because he tempted Eve these feelings have arisen on the part of woman. The Lord God, when he found that Eve fell because of the serpent's temptation, said in his anger, 'I will put enmity between thee and the woman, and between thy seed and her seed.' That accounts for what we observe; it is all very plain." So said the sages of old. It is truly ingenious; but science gives a more simple interpretation, and yet an interpretation which, because it does not pander to the religious self-pride of human beings, in that it does not yield them that distinct rank above all other living things, is less palatable to the majority. Science says that the fear of women for snakes is an inheritance of monkey-like ancestors; that the most terrible foe of the female monkey, the foe most prone to snatch the young one from her, and even to take the mother herself on occasion, was the deadly poisonous snakes. The terror they inspired was so great that there can be no wonder at its survival in the human female of to-day.

Another habit, a relic of what was indulged in for a definite beneficial purpose, remains to the present day—namely, the fondness of children for rolling. It points to the time when our ancestors possessed hairy bodies tenanted by colonies of parasites, and is another example of parasite-irritation shaping animals' habits, alluded to above. These hairy bodies were the homes of many parasites, among which the parents of Pulex irritans and many another Pulex, together with other kinds which need not be specified, were very much in evidence; and then our ancestors, owing to less perfect articulation of joints, or to less perfection in development of the limbs, or to the thick covering of hair, were unable to reach the source of trouble effectively, and could, like horses or donkeys, only alleviate the irritation by rolling. Scratching of the head as a nervous habit, from the association between nervous irritation and actual irritation by parasites, which must also be transmitted to the brain by the nerves, is a relic of similar ancestral parasitically infested animals. It persists now among human beings who are doubtless above suspicion in the matter of unwelcome tenants; and it is a familiar expression of doubt and perplexity among οι πολλοι who may not be altogether so guiltless.

According to the Darwinists, the loss of hair from the body, which man has suffered in comparison with Simial ancestors, is attributable to the benefit he has derived from being able to get rid of his parasites, or from the greater advantage he obtained in the struggle for existence owing to being less troubled with parasites, whose numbers diminished from want of "cover." Such an idea, however, confuses cause and effect in a most remarkable manner. The diminution of parasites is a result of the loss of hair, but it certainly is not the cause of the hair being lost. To make it so is similar to saying that the diminution of trees in newly settled countries is caused by a decrease in the number of wild beasts. It supposes that the greater freedom from parasites was so important to Simial ancestors who lost their hair as to give them immense advantage in the struggle for existence, forgetting that this does not explain the cause of the loss of hair in the first place. With loss of hair once started, some such benefit may be granted; but what caused the loss of hair in the first place? "Spontaneous variation" is no answer at all; what is the cause of the spontaneous variation? This seems too early a stage at which to say Ignosco or Ignoro.

Then this parasite idea ought to be applied to what is going on at the present day—to the loss of hair from the head—but, unfortunately for the parasite theory, it is among "the classes" who are certainly above suspicion so far as parasites are concerned that the loss of hair on the head is most conspicuously shown, while in the case of Hodge, who cannot be regarded in the same manner, loss of hair from the head is decidedly rare. An explanation which pretends to account for what has taken place, and yet fails in application to analogous circumstances at the present day, is not one to be accepted. A true explanation of the loss of hair will explain the present day loss as well as that of the past; the loss of hair from the head as well as that from the body; the loss of hair by the elephant as compared with the mammoth; the loss of hair on the chests of old monkeys; the loss of hair during disease in animals generally; the loss of hair during pregnancy in domestic and other animals; the loss of feathers by penned-up fowls. An explanation which is wholly physiological, and accounts for loss of hair as a pathematic symptom of individual or racial decline, assumes that such loss of hair is an exemplification of a law of reversion, that as progressive ontogenetic or phylogenetic development is, necessarily, progressive acquirement or elaboration, retrogressive development in similar cases is, accordingly, loss or degeneration of characters developed during progression. This explanation, together with the assumption, warranted by evidence, that the longer any character or particular feature has been transmitted in the race, the longer it will withstand adverse influences, may be applied to all the instances of hair loss given above.

In connection with the hair it may be noticed that certain peculiarities in its mode of growth had their origin in the habits of monkey-like ancestors. On a child's head the hair grows from the crown to the forehead; but in animals which move head first on all fours—a rabbit, for instance—it may be noticed that the hair is always directed from front to back, a character acquired by the fact of motion through air in a given direction having imparted a given lie to the hair. Such may be assumed to have been the case with the hair in the ancestors of monkeys; but when it is found, as in Cebus vellerosus, that the hair grows the contrary way—namely, from back to front—some cause must have induced the change. The flow of rain may be cited—the head being hung down, so that the crown is the highest part, and the rain flows off in all directions, giving the hair a lie in accordance. Now, flow of rain in the case of quadrupeds, as well as the tendency of hair to grow according to gravity, unless other causes are more potent, has made the hair on their limbs grow from the body to the extremities. In the case of man, however, and certain monkeys, the hair on the forearm grows in just the contrary direction—namely, toward the elbow. Here, again, according to Darwin, rain has been the modifying agent; the habit of clasping the hands over the head during rain has caused the rain to flow from the hands to the elbows, and has given the hair direction in accordance. These, of course, are "acquired characters"—the lie of the hair is in accordance with certain disposing forces of environment. Such causes do not act on us now; but there are no causes acting to the contrary in a sufficiently potent manner. Consequently we retain by the conservatism of heredity a character acquired in response to the necessities of environment in our pre-human ancestors.

To return to the persistence of habit, the case of sucking may be noticed. Sucking, of course, is the act of childhood—it is one of the most important incidents connected therewith. The baby sucks to satisfy hunger; and associated with sucking are the feelings of warmth, sleep and comfort. But hunger means distress; and sucking to satisfy hunger means sucking to alleviate a particular distress; consequently it has developed into sucking to alleviate any distress or pain generally. Thus, when an infant is hurt, it turns in its distress to its mother; it desires to suck, and it forgets its trouble in sucking. All these associations are potent in later life. It may be observed in many children long after they have given up sucking; when they are cross, or when they are teased, or angry and vexed, they suck their thumbs. Many children in the same way cannot go to sleep without sucking something—their thumbs generally being ready implements for the purpose—so persistent is the association of sucking with sleep. In later life children suck the ends of their pens or pencils when in doubt and perplexity over their lessons, from the association of sucking with distress or anxiety; and in still later life the masher, and the young man whose ideas do not flow very readily, suck the ends of their walking sticks when they are in doubt or anxiety, in conversational or amatorial matters—such act of sucking being a relic of the baby habit acquired by the infant from the association of sucking with alleviation of distress, no matter in what way it was caused. Further, the number of men who suck the ends of their mustaches,* and of women who suck the ends of their crochet or knitting needles, or anything else, whenever they have the least feeling of doubt, annoyance, anxiety, distress, discomfort, or the like, points to the persistence of a youthful habit long after all reason for it has ceased, and forms an instructive lesson in the development of the methods used to express emotions.

In other animals equally curious habits may be noticed, particularly in domesticated animals, because inherent organic conservatism carries into the new state of life habits and instincts useful to the old. The turning round of a dog before it goes to sleep, and what my children call the "kneading dough" action of a cat when before a warm fire, have been noticed before. But it may be remarked that when a cat takes a piece of meat she invariably gives it a shake—a habit acquired by the wild animal to shake off blood drops and any adherent grit obtained by the flesh from contact with the ground, but an entirely useless performance in the case of a domestic cat fed on cooked meat in a carpeted room. Ducks which are kept away from a pond will, when it rains, or when they hear the splashing of water, repeatedly raise and lower their heads with a jerking motion—the same action which they use when in the water in order to throw the water over their bodies to wash themselves. Ducks delight in water, and consequently these washing movements are intimately associated with pleasure. Thus they feel pleasure when they are let out after confinement, though they may not be near water; and this pleasure they express by going through the washing movements—in fact, the association is so strong that these movements have become a conventional expression of pleasure of any kind. Young lambs will mount any hillock in a field, because their wild parents were dwellers in mountainous countries. We ourselves when we wish to express scorn, or contempt, or anger, draw up our lip so as to expose the canine teeth—the weapons with which our monkey ancestors were wont to fight, as has frequently been pointed out. Babies, when they cry—and thus wish to express rage and indignation—draw the mouth into a quadrate shape. This peculiar set of the mouth in a crying infant was noted by Darwin;† but the reason for it does not seem to have been grasped. It arises, however, from the fact that crying is associated with anger, that in anger the fighting instinct is dominant, that the fighting instinct leads to a display of weapons on the noli me tangere principle, that the weapons of our ancestors were caniniform teeth in the upper and under jaws. It may be observed that the lips of a crying baby's mouth are so disposed as to exactly display the caniniform teeth as much as possible; but here comes the curious part of the whole matter—a young baby shows the quadrate shaped mouth more remarkably than older children; yet it has no teeth to display, for the teeth are not to be seen in the gums. Here is a habit, acquired for a definite purpose, persisted in afterward when no means are available for fulfilling the purpose, and yet persisted in because of the long association in ancestors of the weapon display with anger. For a newly born baby to retract the corners of the lips in order to expose teeth which are still hidden in the gum is a ludicrously futile pro-

* Apart from the sedative effects of nicotine, the sucking at a pipe may also be soothing from the inherited association. Some non-smokers suck straws.

† Expression of the Emotions, 2d ed., chap. vi., pp. 155-156.

cess; yet it shows in an extraordinary manner that a habit once acquired may remain, polarized, as it might be called, long after all reason for its acquirement and use had passed away.

From sadness to joy is a very welcome transition; and consequently a few remarks upon the method of expressing pleasure will not unsuitably follow those on the expression of pain. To show that they are pleased human beings frequently draw up and wrinkle the nose the while they elevate the upper lip so as to expose the teeth. The same action may be noticed in terriers to express pleasure, and it is called "grinning;" in children it is a remarkably common feature. It is not general among adults; but when it be a regular habit in any individual it leads to the formation of obliquely transverse furrows each side of the nose, and so gives to the face a definite and somewhat amiable expression, which may degenerate into an unfortunate peculiarity.

The origin of this expression does not seem to have been any wish to expose the teeth, but rather a desire to sniff in as much as possible. Animals derive their greatest pleasures from the satisfaction of the sexual and gastric appetites; and all odors associated with such satisfaction would become pleasing, because they would suggest pleasant ideas to the senses. It would be pleasant, then, to inhale such odors, as the odor of a good dinner is pleasant to a hungry man about to enjoy it; and he expresses his satisfaction by sniffs. The rapid repetition of a series of sniffs in succession, necessitating certain convulsive movements of the stomach, may have been the initiation of that expression of delight called "laughter," which consists in a series of quick convulsive stomachic movements coupled with certain guttural cacklings.

What might be called the genesis of our expressions, or their historical development in the phyletic series to which man belongs, opens a very wide field. Darwin has attacked it in his "Expression of the Emotions;" but, though he has collected a great store of most interesting facts, the theories and conclusions which he formed in connection therewith are sometimes not so satisfactory as they should be. Particularly does this apply to his principle of antithesis, which it is admitted in a note to the 2d edition (p. 52) has not met with much acceptance. This can hardly be wondered at; because it seems so totally opposed to that gradual acquirement and development which the Darwinian doctrine supposes. Space does not allow a further consideration of this subject, more than to say that, like other animals, children's actions when at play show mimic warfare and perverted inheritance of sexual instinct. Love and war, which played such important parts among prehuman ancestors, have left their mark upon children's actions to-day—an influence which can be easily discerned, though it may be sometimes obscured. Even such a matter as the elevation of the eyebrows during astonishment may be traced to the desire of prehuman ancestors to erect the hair, in order to make themselves as big as possible, and therefore formidable to their foes, a habit which animals constantly exhibit when they are suddenly startled. It is the noli me tangere principle, sometimes practiced with good cause, but at other times being the merest "bluff," a veritable trading under false pretenses. It is to this practice of erecting the hair that we owe the involuntary expression during extreme terror—that of the hair standing on end with fright. By disuse we have lost the voluntary power to control the muscles which perform the function of erecting the hair; but the involuntary power still remains. Such seems to be the explanation; at any rate, involuntary erection of the hair during terror is a well known fact, treated of by Darwin.

Enough has been said to show that the characters and habits of children afford every support to the evolutionist; that what is quite unintelligible and even antagonistic to any idea of special creation becomes significant and full of meaning in the light of the doctrine of gradual development; that the actions of children when rightly interpreted tell their own tale and may fitly be compared to ancient monuments of prehistoric times; lastly, that the human infant is an interesting object of scientific research, and that even a cross baby should be calmly contemplated by the philosophic mind.

ECONOMIC ENTOMOLOGICAL WORK IN THE PARKS OF NEW YORK CITY.*

By E. B. SOUTHWICK, New York City.

THE work of the entomologist of the Department of Public Parks in New York City is the care of trees, shrubs and plants in an entomological sense, and is under the direction of the commissioners.

The ground to be covered is about 4,000 acres more or less, but most of the work is confined to the Central and other parks of the city proper. Two men, with the entomologist, constitute the working force, save when the Orgyia cocoons become very abundant; then laborers assist in their removal.

The work is continued the year round every day save Sundays and an occasional holiday. A one horse spraying machine carrying 2½ barrels of liquid is used for the ordinary work of spraying, and a one horse machine with a powerful force pump for knocking off plant lice, cottony scale, etc. Various other tools and appliances are used for the removal of egg masses, webs, bag worm cases, larvæ, etc. The poisons used are those that are now quite commonly accepted to be the best, viz., London purple, Paris green, kerosene, crude petroleum, crude carbolic acid, bisulphuret of carbon, hellebore, pyrethrum, and others. The insect that requires the most attention the year round is Orgyia leucostigma. This species is reduced in several ways.

1. By hand picking, by which means barrels of the cocoons and egg masses are removed each year. This work is carried on through the entire winter, when all the parks have to be gone over and the trees put in as good condition as possible.

2. By jarring the larvæ down with a pole so arranged that a blow from a mallet on a projection placed at the larger end of the pole will jar down any that may be on the limb.

3. By poisoning the foliage with London purple, which is quite effective, and used especially on very large trees that cannot be treated otherwise.

4. By spraying the trunks of large trees that are covered with cocoons with an emulsion of petroleum and carbolic acid. This spray put on with force will penetrate most of the cocoons and destroy the pupæ or larvæ within and many of the eggs that may have been deposited on the outside. This last method is only resorted to when we are unable to subdue them in other ways. Large quantities of the cocoons of this insect are collected each year and taken to the arsenal, where the parasites when bred are allowed to escape from the windows of the building to continue their work of parasitism.

The bag worm, that at one time defoliated whole sections of the park, has been so subdued that it no longer gives us much trouble. Barrels of their cases have been removed from the trees, and each year we remove all that appear in devastating numbers as far as it is possible to do so.

The European leopard moth (Zeuzera pyrina) is one of the worst insects we have to contend with. It works in secret, and not until the damage is done can we locate it. Last season we spent two months on this insect alone, collecting and destroying the larvæ and pupæ. All the affected limbs were collected, the insects removed, and then the limbs were taken to the dump and destroyed by fire, in this way making the work complete. A great many wagon loads were so collected and destroyed, and this work manifested itself this year in the lesser number of trees afflicted. This year we continued the work of collecting, but were only able to give two weeks to it, but with the aid of the gardeners we were able to destroy a great many. I believe the work we have done with this insect alone has saved thousands of trees in our parks that would otherwise have been either destroyed or deformed. This question is a serious one when we are considering such valuable representations of our silva as are collected in our city parks, for when a limb is amputated by this insect the stub is most sure to die, and if the fungus does not immediately take possession of it, it will be amputated by a so-called gardener, who does not see the advisability of protecting the scar from fungi and insects; and here is offered a field for the greedy fungi, whose ever present spores are ready to grow when the proper field offers itself, and they hardly ever fail to take possession, and all over our fine elms can be seen with groups of Agaricus ulmarius in all stages of growth. This close pruning, without proper protection from insects and fungi, is one of the most important questions of our times, for every year great numbers of trees are destroyed for want of proper protection and a knowledge of seasonable pruning.

Right here the sap fly, which I take to be Mycetobia pallipes,* finds congenial habitat, and hundreds of trees are weakened by the flow of sap they cause, besides being unsightly from the slimy frass running down their sides. Those we treat with a crude carbolic acid emulsion sprayed over them; after a time, however, they again show themselves, and have to be treated again.

The elm leaf beetle is another pest that we have to fight, but with the force of two men, and miles of ground to cover, it is very difficult to keep this insect in subjection. Our success has been in preventive measures rather than otherwise. However, we do successfully destroy them when they have spread over the entire tree. As soon as the first eggs are discovered on the leaves, about the 1st of June, we immediately poison the foliage and keep them from spreading. When the larvæ come down to pupate and collect at the base of the tree, we treat them by spraying with an emulsion of kerosene and crude carbolic acid. In this way we destroy bushels of them, and with the spraying are able to keep them in check in our city parks.

The pine Chermes (Chermes pinicorticis) is another insect that is giving us a great deal of trouble, but we can subdue it most effectually with a stiff spray. The tree is then treated with the kerosene emulsion, and also those insects collected or washed down around the base of the tree. This has to be done at least three times a year. For the past seven years I have been using the stiff spray for different work, and it is one of the best means I know for cleaning maples of Pulvinaria. Three years ago Pulvinaria innumerabilis was very abundant on a great number of trees in our parks, and I treated them with the hose and emulsion until I had them in fair subjection. The Chermes and Pulvinaria were at one time taken off with corn brooms, but the spray is much more effectual and gets in among the small twigs without breaking them.

Scale insects are treated with washes and taken off with steel brushes, and are also sprayed with an emulsion, which covers the smaller branches. Eriosoma rileyi is common on our young elms, and these are treated with the kerosene and carbolic emulsion.

The larvæ of the larger silk producers are collected and destroyed, as well as the cocoons. Datanas are collected by hand, as they are assembled in masses, and destroyed. The web worm, always abundant in our parks, is collected either by taking down the twigs or, if the tree is a valuable one, by twisting them out and crushing the larvæ.

Alypia octomaculata is abundant where Ampelopsis is grown. These are effectually destroyed with the London purple solution.

The catalpa trees have been affected by a species of Cecidomyia, which causes the ends of the branches to turn black and break off. These are collected every year and destroyed before the larvæ leave the twigs. Leaf skeletonizers are always abundant on many of our trees, and the Platanus and Liquidambar species have suffered most. These insects are cut off as soon as they can be seen working and destroyed. If left for any length of time, they make the tree very unsightly.

Aphis species are treated with the kerosene emulsion after the colonies have been broken up with the stiff spray. I have found it impossible to get an emulsion to act upon many of the plant lice, on account of the secretion; but let me play the hose on them a short time and they are disintegrated and demoralized, and many are killed outright by the shock; then a fine spray of emulsion will reach them more effectually than otherwise. The more I have occasion to use a force of water, the more I see the benefits that will accrue from it, especially in economic entomological work, for larvæ of many kinds can be knocked down by it, and my men have brought me birds that they have knocked out of a tree and captured.

Other insects that are working on the foliage and in the stems of our plants we have in great numbers, but enough has been said to give an idea of some of the work we try to accomplish. Could we have sufficient force to do the work at the proper time, there seems to be no reason why our parks could not be kept in the best condition, but with a force of but two men, with the entomologist, the wonder is that even a respectable showing can be made and the vegetation kept in as good condition as we now find it.

Mr. Howard said that he was very much interested in Mr. Southwick's account of the use of water as an insecticide, and referred to some experiments in the same line which he had conducted, in which he showed a strong stream of water to be an effective agent against the rose slug and certain other insects.

* Read before the Association of Economic Entomologists, Brooklyn, 1894.—From Insect Life.

* Mr. A. D. Hopkins says it is probably a species of Sciara.—E. B. S.

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